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Teacher-Student Interactions and Domain-Specific Motivation: The Relationship between Students' Perceptions of Teacher Interpersonal Behavior and Motivation in Middle School Science

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TEACHER-STUDENT INTERACTIONS AND DOMAIN-SPECIFIC MOTIVATION: THE RELATIONSHIP BETWEEN STUDENTS' PERCEPTIONS OF TEACHER INTERPERSONAL BEHAVIOR AND MOTIVATION IN MIDDLE SCHOOL SCIENCE

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by
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ABSTRACT

This study examined interactions between middle school science students' perceptions of teacher-student interactions and their motivation for learning science. Specifically, in order to better understand factors affecting middle school students' motivation for science, this study investigated the interactions between middle school students' perceptions of teacher interpersonal behavior in their science classroom and their efficacy, task value, mastery orientations, and goal orientation for learning science. This mixed methods study followed a sequential explanatory model (Cresswell & Plano-Clark, 2007). Quantitative and qualitative data were collected in two phases, with quantitative data in the first phase informing the selection of participants for the qualitative phase that followed. The qualitative phase also helped to clarify and explain results from the quantitative phase. Data mixing occurred between Phase One and Phase Two (participant selection) and at the interpretation level (explanatory) after quantitative and qualitative data were analyzed separately.

Results from Phase One indicated that students' perceptions of teacher interpersonal behaviors were predictive of their efficacy for learning science, task value for learning science, mastery orientation, and performance orientation. These results were used to create motivation/perception composites, which were used in order to select students for the qualitative interviews. A total of 24 students with high motivation/high perceptions, low motivation/low perceptions, high motivation/low perceptions, and low motivation/high perceptions were selected in order to represent students whose profiles either supported or refuted the quantitative results.

Results from Phase Two revealed themes relating to students' construction of their perceptions of teacher interpersonal behavior and dimensions of their efficacy and task value for science. Students who reported high motivation and high perceptions of teacher-student interactions during the quantitative phase described the most instances of teacher cooperative behaviors, such as teacher helpfulness and understanding. Conversely, students reporting low motivation and low perceptions of teacher-student interactions described the most instances of teacher oppositional behavior, such as harsh and impatient behaviors. An in-depth description of categories and subcategories is also provided.

This study concludes with an interpretive analysis of quantitative and qualitative results considered both separately and together. Implications for middle grades science education are discussed, including recommendations for behavior management, scaffolding students' transition to middle school, making explicit connections to science careers, and providing opportunities for small successes within the science classroom. Implications for science teacher education, limitations of the study, and future research directions are also discussed.

DEDICATION

This dissertation is dedicated to the memory of two individuals who, while no longer with us, live on in the influence they have had and continue to have on my life.

First, I dedicate this dissertation to my grandmother, Sara Velma Sweet, who passed away a little over a year ago during my doctoral program. Through her life and example, she taught me the value of hard work, dedication, and compassion. These are all qualities that have enabled me to persevere through challenges during my doctoral program and to maintain a positive outlook in the process. Though she did not have the opportunity to finish high school, she became a successful businesswoman in her community and was an inspiration to me. She took great pride in encouraging her granddaughter to pursue her doctoral degree. I miss her every day, but know that her legacy lives on.

Second, I dedicate this dissertation to my father-in-law, Richard Carl Smart. His passion for learning and love of family far transcend his life and he has left a lasting impression on me. My father-in-law was a college professor and had begun work on his Ph.D. when his parents needed him to help run the family business. He willingly abandoned his academic pursuits to support his family, sacrificing a lifelong dream. His love for family ran deeper than his own ambitions. My father-in-law never had the opportunity to finish his Ph.D.; he passed away seven years ago. His life and passion for education has greatly inspired me in the pursuit of my Ph.D.

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I would like to thank my family for their amazing support throughout my doctoral program and during this dissertation process. My husband, Andrew, has truly been my biggest fan in this pursuit and has encouraged me to persevere through the difficult times and to always keep balance in my life. My parents have also been there to support me, as they have throughout my life. We have had many long conversations on the phone during my long drives to and from Clemson. My mother-in-law has also been a huge source of encouragement, always believing in me. I could not have made it through this program without the love and support of my family.

I would also like to thank my wonderful committee for their guidance during my time at Clemson. Bob, you are truly the best chair anyone could ask for and I appreciate your mentorship and constant encouragement. I always know that you truly have my best interest at heart! To the rest of my committee, I have learned so much from each of you and will be a better professor and researcher because of the influence you have each had in my life. Thank you for being my mentors and my friends.

Thank you also to all of my peers in this doctoral program. I have been honored to learn with you and to share this experience together. I know that we will watch each other do great things in the years to come.

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Chapter One: Problem and Significance

Background of Problem

Teacher-student interactions have the potential to affect students on a variety of levels, including achievement, motivation, and adjustment to school (den Brok, Levy, Brekelmans, & Wubbels, 2005; Pianta, 1999; van den Oord & Van Rossen, 2002). Teacher-student interactions can have a positive effect on a variety of student outcomes, including students' academic development, achievement and attitudes toward learning; this research on teacher-student interactions has been conducted in early childhood, elementary, and secondary settings with similar findings (Burchinal, Peisner-Feinberg, Pianta, & Howes, 2002; O-Conner & McCartney, 2007; Pianta, 1999; Pianta & Nimetz, 1991). Teacher-student interactions can also be predictive of student achievement and motivation as early as the elementary years (Pianta & Nimetz, 1991) and potentially continuing into the middle grades (den Brok, Levy, Brekelmans, & Wubbels, 2005; O'Conner & McCartney, 2007). Teacher-student interactions may even have a mediating effect for students with developmental vulnerabilities and insecure maternal attachments (Baker, 2006; O-Conner & McCartney, 2007). In some cases, high quality teacher-student interactions provide a "protective effect" for at-risk students in comparison to similar students who lack these interactions (Baker, 2006).

Defining the characteristics of high quality teacher-student interactions is critical to examining their impact on student outcomes. Gardiner & Kozmitzki (2008) defined high quality teacher-student interactions as consistent, stable, respectful, and fair interactions that facilitate the student view of their teacher as a secure base. Students who view their teacher as a secure base are more likely to engage in help-seeking behaviors which, in turn, positively correlate with student achievement (Gardiner & Kozmitzki, 2008). High quality teacher-student interactions can also be typified by rich communication in instructional exchanges between the teacher and student (Pianta, 1999). Open communication between teacher and students can enable students to engage more deeply with content through classroom discourse and seek teacher assistance more confidently. Perceived emotional support is also a characteristic of high-quality interactions; this perceived support also has links with increased student achievement and academic motivation (Pianta, La Paro, Payne, & Cox, 2002).

Research indicates that teacher-student interactions are influential in student outcomes in science (den Brok, Levy, Brekelmans, & Wubbels, 2005). Specifically, students' perceptions of interactions with their teachers are highly correlated with students' attitude towards science (Brekelmans, Wubbels, & den Brok, 2002; den Brok, 2001; Fraser, 1998). However, this line of research has focused primarily on secondary science students; the present study seeks to extend this research to middle grades science education. In addition, previous studies specific to science focus on students' *general* attitudes toward science. The present study focuses specifically on students' motivation for learning science, extending the current research on teacher-student interactions to examine the constructs of task value, self-efficacy, and goal orientation.

The present study focuses specifically on science motivation as defined by the theories of expectancy-value (Eccles, 1984; Eccles, Adler, & Meece, 1984; Eccles & Wigfield, 1992; Wigfield, 1994), self-efficacy (Bandura, 1977, 1979), and goal orientation (Ames, 1992; Pajares, Britner, & Valiante, 2000). Students as young as eight years have demonstrated the ability to differentiate between subject areas in relation to motivational constructs (Anderman, 2003). Subject-specific motivation represents the values, attitudes, and conceptions that a student holds toward a specific academic domain (den Brok, et al, 2005). Studies indicate that motivation can differ from one subject to another, especially in early adolescents (Stodolsky, Salk, &

Glasessner, 1995; Wolters, 2004). As students move to middle grades where subject areas are more departmentalized and integration of subjects is less common than in elementary grades, motivational constructs may differ by domain.

Since motivation and achievement can be highly correlated (DiPerna, Volpe, & Elliott, 2005; DiPerna & Elliott, 1999; Whang & Hancock, 1994), it is critical that students maintain an optimal level of motivation. However, research indicates that many students display a downward motivational shift in middle school, especially in the area of science (Anderman, Maehr, & Midgley, 1999; Eccles & Midgley, 1989). Motivational patterns in middle grades often remain stable into high school and beyond, thereby influencing students' course selection and ultimately affecting their career trajectories (Eccles & Midgley, 1989). In light of this research, it is critical that students maintain a high level of motivation during the middle grades. A problem arises not only in the drop in science motivation during middle school, but also an incomplete understanding of factors influencing this motivational shift. Several hypotheses exist to explain, at least in part, this drop in motivation, including reasons such as developmental factors, peer factors, school characteristics, and parental involvement (Ryan & Patrick, 2001). Many of these factors may be outside the realm of teachers' control and influence.

However, some research also indicates that middle school students' domain-specific motivation may be affected by teacher factors (Anderman, Maehr, & Midgley, 1999, Eccles & Midgley, 1989). Students' perceptions of various aspects of their interactions with their teachers may be predictive of their motivation for learning science. Teacher behaviors that provide support during instruction (Goodenow, 1993; Fraser & Fisher, 1992), promote interaction (Webb & Palincsar, 1996; Keating, 1990), encourage mutual respect (Turner, Thorpe, & Meyer, 1998), and encourage the establishment of mastery goals (Midgley, Anderman, & Hicks, 1995) may be linked to increases in students’ domain-specific motivation during middle grades. However, this research is not specific to the interaction of teacher behavior and *science* motivation in the middle grades. This research focused primarily on motivation for learning mathematics; consequently, the present study adds to the current literature on domain-specific motivation in the middle grades and interactions with teacher interpersonal behaviors. By understanding these factors in relation to middle school science, it may be possible to identify aspects of teachers’ interpersonal behavior that can predispose students to developing optimal motivation for learning science.

Statement of Problem

The purpose of this study is to examine interactions between middle school science students' perceptions of teacher-student interactions and related science motivation. Research has demonstrated a correlation between teacher-student interactions and a variety of student outcomes, including student attitudes and achievement (DenBrok, Levy, Brekelmans, & Wubbels, 2005; Pianta, 1999; van den Oord & Van Rossem, 2002). In addition, many students display a drop in motivation for science during the middle grades (Anderman, Maehr, & Midgley 1999; Eccles & Midgley, 1989). Since motivation has been shown to correlate positively with achievement (DiPerna, Volpe, & Elliott, 2005; DiPerna & Elliott, 1999; Whang & Hancock, 1994), it is a critical component in students' trajectories for academic success.This study investigates interactions between middle school students' science motivation and their perceptions of teacher-student interactions in the classroom in order to better understand factors affecting middle school students' motivation for science.

This study follows a sequential explanatory mixed methods design and consists of a quantitative and qualitative phase (Cresswell & Plano Clark, 2007). Specifically, this study follows a participant selection model; quantitative data from the first phase was used to select participants for the second qualitative phase of the study. The following research questions guided the present study:

- (Overarching) What relationship exists between middle school science students' perceptions of teacher-student interactions and their motivation for learning science?
- (Quantitative phase) To what degree are students' perceptions of teacher-student interactions predictive of their motivation for learning science?
- (Qualitative phase) How do middle school science students 'perceptions of teacher-student interactions affect their task value, self-efficacy, and goal orientation for learning science?

Significance of Study

Research on teacher-student interactions and related student attitudes in science has grown in scope and focus over the past decade (Wubbels & Brekelmans, 2005). This line of research has been conducted all over the world and offers a unique cross-cultural perspective in students' perceptions of classroom interactions and how these affect student attitudes for learning science. However, the majority of research on teacher interpersonal behavior and students' science attitudes has been conducted within secondary settings, usually grade nine and higher (Wubbels & Brekelmans, 2005). While there have been attempts to extend this research into the primary grades (den Brok, Fisher, & Scott, 2005), these studies are outnumbered by those conducted with students in grades nine and higher. Unrepresented in this line of research are the middle grades. In a thorough search of the current literature base, I was unable to find a study that specifically focused on middle school students' science motivation and perceived teacher interpersonal behavior. The study of science motivation during middle grades, and factors affecting this motivation, is critical since many students report low motivation for science during the years between elementary and high school. Research indicates that students' motivational patterns remain fairly stable as students move through middle and high school (Eccles, Wigfield, & Schiefle, 1998; Migdley, Anderman, & Hicks, 1995). Consequently, maintaining student motivation at the middle school level can have positive implications for enduring attitudes about science and, ultimately, career trajectories.

In addition, most research on teacher interpersonal behavior and student science attitudes has been conducted outside the US; there are few studies that examine how student attitudes in the US are affected by teacher-student interactions. While the international nature of this line of research provides unique opportunities for cross-cultural comparisons, making generalizations to US education from international studies is problematic. The current study will add to the literature on US students' perceptions of teacher interactions and how this affects their motivation in science. Since no previous studies have specifically examined these constructs within the context of US middle grades education, the present study will add a unique dimension to this international line of research.

This study also extends the current literature by uniting research on teacher interpersonal behavior and research on motivation. While previous research on teacher-student interactions has focused on student attitudinal outcomes, these studies were generally focused on a general measure of student attitude or enjoyment of science (Wubbels & Brekelmans, 2005). The present study focuses specifically on constructs of student motivation, framed by the following motivational theories: expectancy-value, self-efficacy, and goal theory. This detailed focus on student motivation extends the general attitudes studies previously conducted in relation to teacher-student interactions. Motivation is a critical component of student learning. Highly motivated students are more likely to engage in effective goal-setting, make healthy attributions for success and failure, and persist in academic challenges (DiPerna, Volpe, & Elliott, 2005; DiPerna & Elliott, 1999; Whang & Hancock, 1994). Compared to students with lower motivation, highly motivated students report more value for academic subjects and view these content areas as more relevant to their lives (Eccles & Wigfield, 1994; Pintrich & Schunk, 2002). Motivation has also been connected to a students' use of metacognitive strategies and level of cognitive engagement (Pintrich & DeGroot, 1990a).

This study is also significant because it utilizes a mixed methods research design to examine constructs which are usually measured quantitatively. Previous studies have primarily relied upon quantitative data to measure students' perceptions of teacher-student interactions and science motivation. The present mixed methods study includes a qualitative component in order to provide a more comprehensive view of the relationship between teacher-student interactions and student motivation in science. This design allows for the collection of different yet complementary data and provides for a direct comparison of quantitative statistical results with qualitative findings in order to validate, corroborate, and expand the findings from the quantitative phase.

As discussed above, teacher-student interactions can have profound effects on student outcomes (denBrok, Levy, Brekelmans, & Wubbels, 2005; Pianta, 1999; van den Oord & Van Rossem, 2002). The current study builds on this previous research in the following ways: (1) This study extends research on teacher interpersonal behavior and student science motivation into the middle grades. Previously, this line of research has been dominated by studies in secondary science education; the present study examines these constructs in a middle grade setting. (2) This study contributes to the international literature on teacher interpersonal behavior and student attitudes in science by focusing on a population of US students. While there are no known middle grades studies to use as a comparison internationally, the present study offers a basis for comparison of broad cross-cultural themes in students' perceptions of teacher behaviors and related science attitudes. (3) The current study takes an in-depth look at a specific aspect of student attitudes towards science: motivation. While previous studies have examined student science attitudes on a broad scale, often highlighting enjoyment, the current study is grounded in specific motivational theories to guide an examination of student task value, self-efficacy, and goal orientations for learning science. (4) This study extends the current literature of teacher-student interactions and science attitudes by using a mixed methods design to examine these constructs both quantitatively and qualitatively. The combined strengths of these methods allowed for a comprehensive analysis of various dimensions of students' perceptions of teacher interpersonal behavior and science motivation; quantitative measures alone, as used in previous studies, offers a limited view of these constructs.

Limitations of the Study

Several factors function as limitations in the present study. Student interest in the survey and value for the topic may have influenced students' answers to questions or affected the amount of time spent on each item. Classroom interruptions such as visitors and announcements could have also affected students' focus on the survey completion. Though attempts were made to shorten surveys (discussed in detail in Chapter Three), fatigue factors could have also affected students' attention to survey items and accuracy of response. Student interviews may have also been affected by student factors (demeanor of student, value of student for task, comfort level with researcher) and other variables that were not easily controlled in a school setting (noise level, interruptions, presence of peers). Further limitations of the current study are discussed in Chapter Five in relation to the interpretation of study results.

Organization of the Study

Chapter One has presented the introduction, background on the problem, statement of the problem, significance of the study, and limitations of the study. The review of related literature and research on teacher-student interactions and science motivation are presented in Chapter Two. Chapter Three contains the method and procedures used in data collection and analysis for the quantitative and qualitative phases of this study. Chapter Three also contains a description of the instrumentation and data mixing procedures. Data analysis, findings from the quantitative phase, participant selection procedures, and findings from the qualitative phase are presented in Chapter Four. Chapter Five contains a summary of findings from the study, conclusions, a discussion, implications for education, and recommendations for future studies.

Clarification of Terms

In this section, constructs represented within this study will be defined and clarified.

Teacher-student interactions: The exchanges between teacher and student that occur within the context of the classroom. These interactions can fall into either instructional interactions or interpersonal interactions (Pianta, 1999; van den Oord & Van Rossen, 2002).

Teacher Interpersonal Interactions/Behaviors: Those behaviors that specifically relate to how teachers interact with their students on a personal, affective level. These interactions are frequently described in terms of dimensions of teacher proximity to students (cooperative behaviors vs. oppositional behaviors) and their influence (dominance vs. submission) (Leary, 1957; Wubbels & Brekelmans, 2005).

Proximity: Teacher proximity is an aspect of the Model for Teacher Interpersonal Behavior (Leary, 1957). This construct is defined by the dimensions of cooperative behaviors and oppositional behaviors. Included in cooperative behaviors are: leadership, helpful/friendly, understanding, student freedom. Included in oppositional behaviors are: uncertain, dissatisfied, admonishing, strict.

Influence: Teacher influence is also an aspect of the Model for Teacher Interpersonal Behavior (Leary, 1957). This construct is defined by the dimensions of dominant behaviors and submissive behaviors. Dominant behaviors are: admonishing, strict, leadership, helpful/friendly. Submissive behaviors are: dissatisfied, uncertain, student freedom, understanding.

Motivation: Motivation can be defined as “the processes that energize, direct, and sustain behavior” (Santrock, 2004, p. 414)

Expectancy-value: This theory holds that motivation is a function of an individual’s expectancy for success for a given task and the individual’s value for the task (Eccles, 1984; Eccles, Adler, & Meece, 1984; Eccles & Wigfield, 1992; Wigfield, 1994).

Self-efficacy: The confidence that an individual has for their ability to perform a specific task. (Bandura, 1977, 1997)

Goal theory: Goal orientation refers to students’ achievement goals, or “the reasons that students have for doing their academic work.” These achievement goals are typically describes as either performance goal orientations or mastery goal orientations (Pajares, Britner, & Valiante, 2000).

Performance goal orientation: Typified by a focus on competition, comparison to others, and either displaying competence (performance-approach) or avoiding failure (performance-avoid) (Midgley, Anderman, and Hicks, 1995; Midgley, Kaplan, & Middleton, 2001).

Mastery goal orientation: Characterized by a focus on personal progress, improvement, and learning for learning's sake (Midgley, Anderman, & Hicks, 1995; Midgley, Kaplan, & Middleton, 2001).

Mixed methods design: A research design in which quantitative and qualitative data are both collected and mixed at some point in the study. Depending on the specific design, quantitative and qualitative data may be collected separately or at the same time, analyzed separately or concurrently, and mixed at various points in the study (Cresswell & Plano-Clark, 2007).

Sequential explanatory mixed methods design: This design consists of a phase one: quantitative phase followed by a phase two: qualitative phase. The primary purpose of this design is to use quantitative results to inform/guide the selection of participants for the second qualitative phase (participant selection model) or to develop detailed explanations of the quantitative results from the first phase.

Middle grades: In the context of this study, middle grades education refers to grades six through eight in the United States public school system. It should be noted that districts vary on their classification of this level of education. Some school districts, such as the site for the present study, group sixth through eighth grades into middle school. Other districts may educate sixth graders within the elementary setting and then group seventh through ninth graders into junior high. For the purposes of the present study, middle grades education refers to sixth through eighth graders within the context of a middle school.

Chapter Two: Review of Related Literature and Research

Chapter Two provides a review of the literature and research relating to teacher-student interactions and science motivation with a focus on the middle grades. This chapter is organized into sections that include (a) factors affecting teacher-student interactions (b) dimensions of teacher-student interactions (c) motivational theories (expectancy-value, self-efficacy, goal orientation) (d) domain-specific student motivation, (e) teacher-student interactions and science attitudes and (f) motivation in the middle grades.

Introduction

Interactions between teachers and students in the classroom can have a prominent effect on student outcomes. These interactions have the potential to affect students in a variety of areas, including achievement, motivation, and school adjustment (DenBrok, Levy, Brekelmans, & Wubbels, 2005; Pianta, 1999; van den Oord & Van Rossem, 2002). Teacher-student interactions can affect a variety of student outcomes. Research has identified positive correlations between high quality teacher-student interactions and students' academic development (Burchinal, Peisner-Feinberg, Pianta, & Howes, 2002; O-Conner & McCartney, 2007; Pianta, 1999; Pianta & Nimetz, 1991); high quality teacher-student interactions have also been shown to be predictive of student achievement in early elementary years (Pianta & Nimetz, 1991).

Teacher-student interactions may also influence student outcomes in the middle grades. Teacher behaviors that provide support during instruction (Goodenow, 1993; Fraser & Fisher, 1992), promote interaction (Webb & Palincsar, 1996; Keating, 1990), encourage mutual respect (Turner, Thorpe, & Meyer, 1998), and encourage the establishment of mastery goals (Midgley, Anderman, & Hicks, 1995) may be linked to students' domain-specific motivation during middle grades. However, this research is not specific to the interaction of teacher behavior and *science* motivation in the middle grades. This research has focused primarily on motivation for learning mathematics and general attitudinal measures in academic domains; consequently, the present study adds to the current literature on teacher interpersonal behaviors in the middle grades and related science motivation.

This chapter first reviews literature on factors that affect teacher-student interactions as well as dimensions of teacher-student interactions as situated in theoretical frameworks from developmental psychology and educational psychology. Next, this chapter details several motivational theories with an emphasis on the following constructs: expectancy-value, self-efficacy, and goal orientation. This discussion narrows to a review of the literature on teacher-student interactions in science and related science motivation. Finally, this chapter addresses motivational issues unique to middle grades.

Factors Affecting Teacher-Student Interactions

Behavior Management Beliefs and Practices

Teachers' beliefs and practices concerning behavior management are influential in shaping teacher-student interactions that occur within the classroom (Morris-Rothschild & Brassard, 2006). Studies indicate that there is a relationship between teachers' behavior management practices and teacher-student interactions (Morris-Rothschild & Brassard, 2006; Shin & Myung-Sook, 2007). In particular, these studies have focused on the attitudes and beliefs that teachers hold regarding classroom control and how these attributes relate to the quality of the classroom environment and the interactions between teachers and students. Morris-Rothschild & Brassard (2006) found that teachers who held positive attitudes regarding the use of constructive conflict management strategies were more effective in fostering a positive classroom environment, facilitating the development of higher-quality interpersonal relationships with their students. These positive classroom interactions are also more likely to be facilitated by teachers who have higher efficacy for managing student behaviors (Morris-Rothschild & Brassard, 2006). This 2006 study consisted of survey data from 283 elementary teachers who reported their efficacy for classroom management and their attitudes toward constructive classroom management strategies. Teachers who reported high efficacy for managing student behavior were more likely to use student-centered approaches to classroom management that focused on a mutual respect between teacher and students. In contrast, teachers who reported low efficacy for managing student behavior tended to default to teacher-centered management practices with an emphasis on high teacher control and low student input in classroom processes. It is important to note that teacher efficacy for classroom management could also be correlated with other teacher factors, such as efficacy for instruction or years of teaching experience.

These other teacher factors could also be influential in the classroom management practices that a teacher adopts in the classroom. Teachers' beliefs about classroom control and prior experiences often lead them to favor one particular management approach over another (Smart & Igo, 2008). The management model that teachers choose to implement in their classroom can affect their subsequent interactions with students (Lerner, 2003). Traditionally, most models of behavior management have been based upon the principles of behaviorism (Levin & Nolan, 2007). A behaviorist approach focuses on shaping student behavior through the application of reinforcements and punishments. Many behavior management approaches are largely teacher-centered; the student plays a passive role while the teacher is in control of administering rewards and punishments. This approach has been criticized for the lack of opportunity for student initiative and an emphasis on teacher control (Good & Brophy, 1997).

Behaviorist management models have also been associated with negative teacher-student interactions stemming from the use of punitive and harsh penalizing discipline measures and a lack of student-centeredness (Brophy, 1996; Tollefson, 2000).

On a continuum of teacher power bases, behaviorist models of management are high on the need of teachers to actively control student behavior (Levin & Nolan, 2007). Other approaches to behavior management represent varying levels of teacher power, ranging from low to moderate. At the lower end of the teacher power continuum are child-centered, or child-directed, philosophies. Child-centered management models were born from criticisms of behaviorist models of classroom management. Stemming from principles of cognitive learning theory, child-centered models are characterized by student ownership in classroom procedures and a shared responsibility between the teacher and student for behaviors and consequences (Levin & Nolan, 2007). In these classrooms, students are expected to take an active role in creating a positive classroom community and developing self-regulatory skills in relation to behavior (Lerner, 2003).

In a study by Lewis, Romi, Qui, & Katz (2005), students reported more positive interactions with teachers who implemented child-centered models of management in their classrooms. This study examined the perceptions of students (N=5221) in Australia, China, and Israel in relation to teachers' behavior management practices. Students in Chinese secondary schools reported the most favorable interactions with their teachers, noting that their teachers regularly valued students' voices in the classroom and offered individual support during instruction. Students in Australia and Israel reported more punitive teacher management strategies (i.e. aggression, controlling) and also perceived more negative interactions with their teachers. Though these results are supportive of the idea that student perceptions of teacher-student interactions are related to teachers' management practices, it is important to note that these studies took place across three very different cultural settings. Intervening cultural factors could affect the way that students perceive certain teacher practices, so results should be examined carefully in light of these considerations.

Common behavior management practices in US classrooms. The Shin and Myung-Sook (2007) study cited above is one of the only reported studies of US teachers' classroom management practices. In general, research reports that US teachers often exhibit teacher-centered practices of student management focused on explicit teacher classroom control with an emphasis on continual monitoring of student behavior (Shin & Myung-Sook, 2007; Smart & Igo, 2008). Teacher factors such as race, gender, and socio-economic status have not been found to influence US teachers' classroom management practices. However, variations in classroom management attitudes have been noted to be a function of classroom experience (Rimm-Kaufman, Storm, Sawyer, Pianta, & LaParo, 2006). Pre-service teachers who are early in their teacher education programs and have limited classroom experience typically place greater value on nurturing students. As these pre-service teachers progress through their programs and gain more classroom experience through field placements and student teaching, they tend to place greater emphasis on their role as an authority figure and a belief in teacher control of classroom management procedures (Rimm-Kaufman, et al., 2006). As teachers move into their early professional years, novice educators report implementing teacher-centered classroom management practices that are modeled after their student teaching experiences or mimic veteran mentor teachers' practices (Smart & Igo, 2008). A search of the research on classroom management reveals no studies on US teachers' attitudes and practices in student management as they progress past the novice years in the classroom. Since these management practices can affect teachers' subsequent interactions with students in the classroom, it is critical to understand how teaching experience interacts with teacher interpersonal behavior.

Dimensions of Teacher-Student Interactions

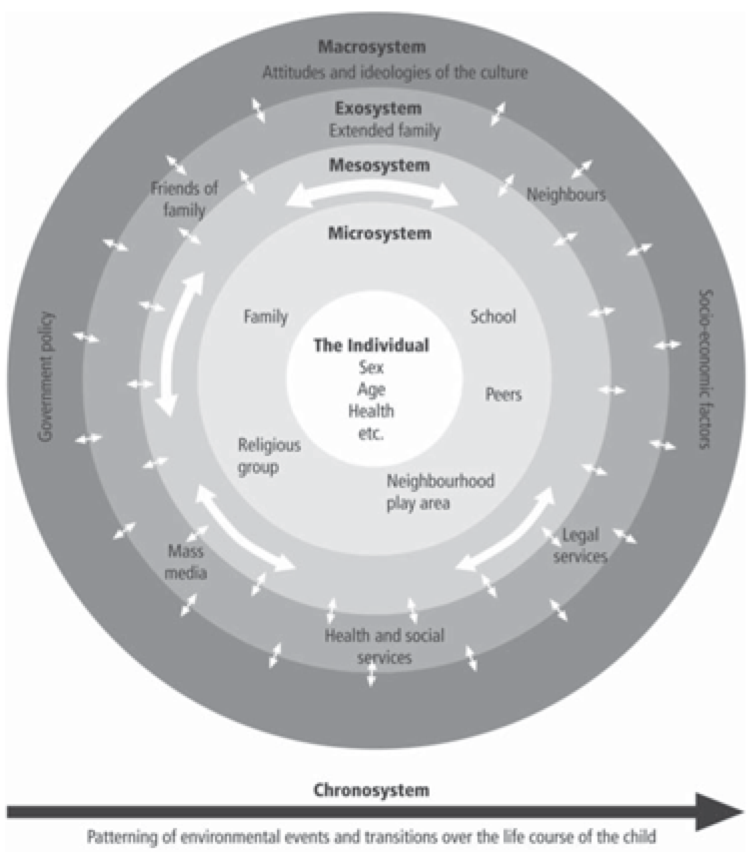
As previously stated, teacher-student interactions have the potential to affect students on a variety of levels, including achievement, motivation, and school adjustment (denBrok, Levy, Brekelmans, & Wubbels, 2005; Pianta, 1999; van den Oord & Van Rossen, 2002). In this section these interactions are first considered in light of an ecological-contextual model of development in order to situate their relevance to the individual student's development as a whole. This model contextualizes the role of teacher-student interactions in relation to a variety of additional factors affecting student outcomes.

Ecological-Contextual Model

Bronfenbrenner's Ecological Model (1977) presents a framework of nested systems which represent an individual's dynamic interaction with extending levels of proximity. This model is graphically displayed in Figure 2.1. This model views a child as "a dynamic evolving being that interacts with, and thereby restructures, the many environments with which it comes in contact" (Gardiner & Kosmitzki, 2008, p.22). At the center of this model is the individual, with all of his or her unique genetic and demographic characteristics that distinguish him or her from others. These individual characteristics can have an effect on the nature of classroom interactions, with the recognition that the dynamic nature of the child both interacts with and shapes these interactions. Bronfenbrenner's model then progresses to the microsystem, which includes all of the child's immediate interactions, which encompass home and school. Within this model, all of these interpersonal relationships are tightly woven, making it impossible to simply isolate teacher-student interactions without acknowledging the interplay between family and peers. While the primary focus of the present study is to examine these teacher-student relationships, this is done while cognizant that these interactions do not stand alone and separate from this greater ecological model of development. Moving outward further in Bronfenbrenner's model, the child interacts with the exosystem, composed of individuals indirectly connected to the child, and finally with the macrosystem, which accounts for cultural influences. Cross-cultural research has shown that this macrosystem accounts for many variations in teacher-student interactions across cultures (Lewis, Romi, Qui, & Katz, 2005; Shin & Myung-Sook, 2007).

Figure 2.1

Bronfenbrenner's Ecological Systems Model (Gardiner & Kosmitzki, 2008)



Drawing from aspects of Bronfenbrenner's Ecological Model, Pianta & Walsh (1996) developed the Contextual Systems Model (CSM) for analyzing children's experiences in school. This framework posits that the following four main systems interact to influence the development of the child: the individual child, family, classroom, and culture. Within the child level, the CSM includes the influence of individual characteristics related to cognitive and biological factors (O'Conner & McCartney, 2007). As the model progresses outward, maternal and family relationships are considered within the family level. The third level of the CSM provides a focus for the present study. Interactions within the classroom level include teacher-student relationships and peer relationships, though the current study focuses primarily on teacher-student interactions (Pianta & Walsh, 1996). The CSM model provides a framework to view teacher-student relationships as situated within the broader context of classroom interactions. Aspects of classroom environment also interact with teacher-student factors, creating a complex web of variables to consider and analyze. (O'Conner & McCartney, 2007). As in Bronfenbrenner's model, all of these classroom factors interact dynamically at any given time. The fourth level, culture, can also affect teacher-student interactions. Studies have revealed ethnicity and cultural factors to be influential in the quality of teacher-student relationships (Kesner, 2000; Saft & Pianta, 2001). In schools where student populations are culturally-diverse, the interactions between cultural variables and teacher-student factors can influence classroom interactions.

Impact of Teacher-Student Interactions

With an ecological-contextual model as a framework for examining teacher-student interactions, we have a basis for considering the impact of these interactions. High-quality teacher-student interactions look to positively affect a variety of student outcomes. Here we must address the question: What typifies “high quality teacher-student interactions?” Birch & Ladd (1996) illuminate this point when they describe interactions in which the student views the teacher as a secure base from which to explore the learning environment and to interact with the classroom community. Teacher-student interactions that are consistent, stable, respectful, and fair can facilitate the student view of the teacher as a secure base. This concept of a secure base mirrors literature on maternal attachments, whereby children with secure attachments interact more freely and confidently with their environments (Gardiner & Kozmitzki, 2008). High quality teacher-student interactions can also be typified by rich communication in instructional exchanges between the teacher and student (Pianta, 1999). Open communication between teacher and student can enable the student to engage more deeply with content through classroom discourse and allow the student to seek teacher assistance more confidently. Pianta, La Paro, Payne, and Cox (2002) found that emotional support from the teacher, another characteristic of high-quality interactions, can enhance student achievement. Emotional support includes verbal and non-verbal messages from the teacher that help them to view the teacher as a support for them during academic and personal challenges. However, this study was conducted with Kindergarten students; results are difficult to generalize to students in upper grades, especially in the context of the current study.

Research has identified positive correlations between students’ academic achievement and high quality teacher-student interactions (Burchinal, Peisner-Feinberg, Pianta, & Howes, 2002; O-Conner & McCartney, 2007; Pianta, 1999; Pianta & Nimetz, 1991). Burchinal, et al (2002) found that a close teacher-student relationship was positively correlated with reading competence and development of language skills. This longitudinal study, conducted with students beginning in Kindergarten through Grade Two, indicated that teacher-student interactions were predictive of language skills development, especially with at-risk student populations. Higher quality teacher-student interactions in early childhood experience have also been shown to be predictive of student achievement in early elementary years (Pianta & Nimetz, 1991). Hamre & Pianta (1999) found high quality teacher-student interactions to be critical factors in fostering cognitive skills development in the early grades.

Teacher-student interactions in elementary school may also be predictive of student achievement in later grades (O'Conner & McCartney, 2007). O'Conner and McCartney (2007) conducted a longitudinal study which examined the academic trajectories of over 1,000 students are they progressed from first through sixth grades. Researchers identified correlations between teacher-student interactions and student achievement; students who experienced positive teacher-student interactions displayed higher levels of academic achievement as they moved through the late elementary grades. Secondly, positive teacher-student interactions also mediated the effects of insecure maternal attachments and helped these students to perform academically at levels comparable to students with stable maternal attachments. This study demonstrated the positive effect that teacher-student interactions can have on students' academic achievement during early to late elementary grades. However, this study examined academic achievement in language arts and mathematics; no measure of science achievement was used in this study. Science is often underrepresented in studies of teacher-student interactions and achievement; many studies, such as the O'Conner and McCartney (2007) study, use standardized measures that focus on skills related to reading comprehension, literacy skills, and computation. While the current study does not focus on achievement, it does offer an insight into unique motivational constructs associated with students' science learning and teacher-student interactions. Since motivation and achievement have been found to be highly correlated, it may be possible to make inferences about how teacher-student interactions in science affect not only student motivation in science, but also science achievement.

Student Perceptions of Teacher-Student Interactions

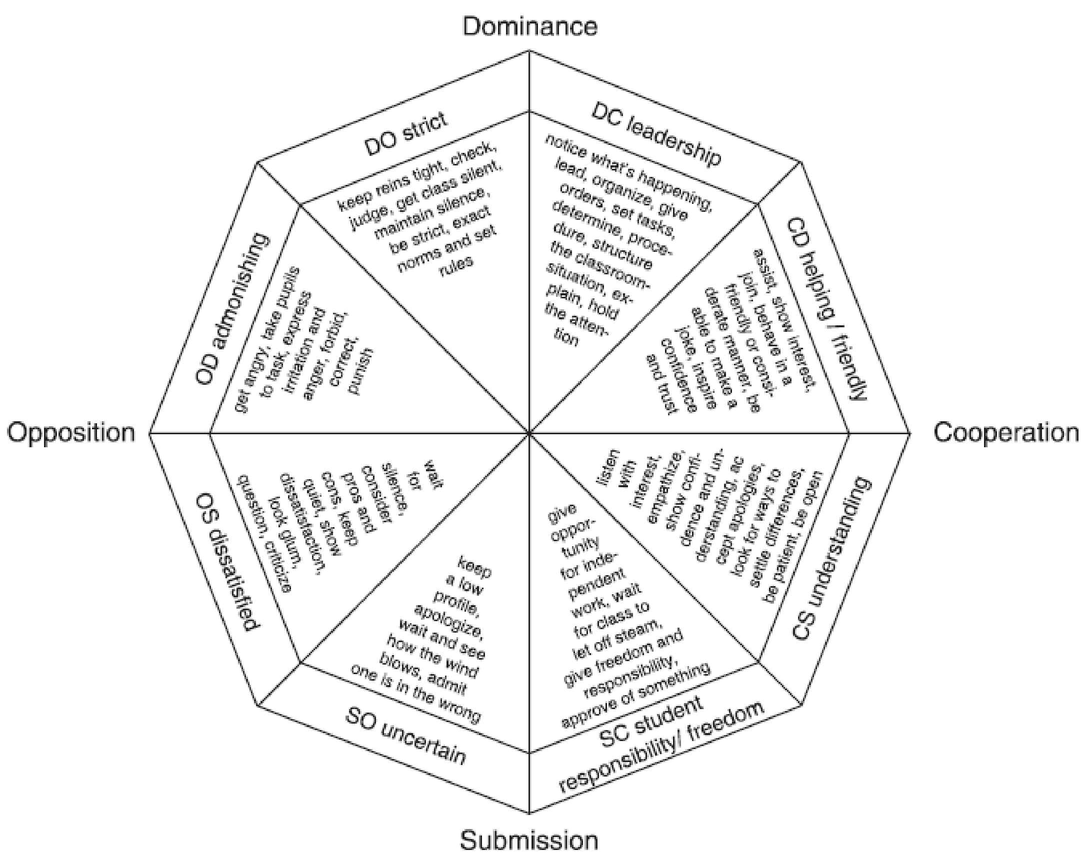
In measuring the effect of teacher-student interactions, the emphasis should be placed on students' perceptions of these interactions. It is the students' actual perception of the interactions that affects student outcomes such as motivation and achievement (Ryan & Patrick, 2001). den Brok, et al. (2005) state that "it can be assumed that learning and motivation are determined to a large degree by their (students) perceptions" (p. 22). Teacher perceptions of classroom interactions often differ significantly from students' perceptions of these interactions (Wubbels & Brekelmans, 2005). For example, teacher perceptions of their leadership and helping behavior have been shown to differ significantly from student perceptions of teacher behaviors (Rickards & Fisher, 2000). Student perceptions of teacher-student interactions can be affected by a variety of factors including cultural differences, gender, and prior experiences (Levy, Wubbels, Brekelmans, & Morganfield, 1997). Consequently, it is essential to understand teacher-student interactions from the students' perspective in order to understand how these interactions affect student outcomes.

Multiple instruments have been developed in an effort to measure students' perceptions of teacher-student interactions. In recent years, the Questionnaire on Teacher Interaction (QTI) has emerged as the primary measure of these student perceptions (Ryan & Partick, 2001). The QTI was designed in order to measure student perceptions of teacher-student interactions (Wubbels & Brekelmans, 1998). The instrument is based on a theoretical model of proximity (cooperation vs. opposition) and influence (dominance vs. submission).This theoretical model, The Model of Interpersonal Teacher Behavior (MITB) (Figure 2.2), originated out of Leary's

(1957) studies on interpersonal diagnosis of personality. Proximity refers to the cooperative behaviors of the teacher while influence refers to tendencies of dominance by the teacher in classroom interactions (Wubbels & Brekelmans, 1998). These two dimensions form a coordinate system with sections divided into eight equal parts, mirroring eight scales of teacher interpersonal behavior. The eight scales of the QTI assess students' perceptions of their teachers' interpersonal behavior along a variety of dimensions, including helping behaviors, leadership, and cooperation. This instrument is described in detail in Chapter Three of this proposal and served as the measure of students' perceptions of teacher-student interaction in the present study.

Figure 2.2

Model for Teacher Interpersonal Behavior (Wubbels & Brekelmans, 2005)



Student Motivation

Motivation is a psychological construct that is fundamental to students' academic success (Schunk, 1991). Broadly, motivation can be defined as "the processes that energize, direct, and sustain behavior" (Santrock, 2004, p. 414) Highly motivated students may be more likely to engage in behaviors that enhance academic performance (DiPerna, Volpe, & Elliott, 2005; DiPerna & Elliott, 1999; Whang & Hancock, 1994), including effective goal-setting, focusing effort, and persisting in academic challenges (Ormrod, 2006). Highly motivated students also are more likely to view academic tasks as valuable and important (Eccles & Wigfield, 1994; Linnenbrink & Pintrich, 2002). Pintrich and Degroot (1990) conducted a study of 173 seventh grade science students to examine interactions among students' self-efficacy, intrinsic value, self-regulation, learning strategies, and performance in science. Results indicated a positive correlation between self-efficacy and performance; a positive correlation was also identified between self-efficacy and intrinsic value for science. In this study, self-efficacy and self-regulation were two of the best predictors of students' performance. Motivational constructs were measured using self-report instruments and student performance data were gathered from students' work on school assignments (e.g. tests, quizzes, reports). This study also demonstrated the connections among various motivational constructs, such as self-efficacy, task value, and student performance. Though the sample size (N=173) was low and not as statistically powerful as a larger sample, this study laid the foundation for future studies focused specifically on the relationship between motivation and achievement. Interestingly, this study remains one of the best examples of an empirical study conducted with middle grades science students in relation to their motivation and achievement.

Motivation has also been connected to a students' level of cognitive engagement and use of metacognitive strategies (Pintrich & DeGroot, 1990a). Students who exhibit high motivation for a task are more likely to utilize effective cognitive strategies for encoding new information (Ryan, Ryan, Arbuthnot, & Samuels, 2007). These students display a tendency to employ critical thinking skills in problem-solving situations and integrate prior knowledge with new information. Walker, Greene, and Mansell (2006) conducted a study with college students to explore the interactions between self-efficacy, intrinsic and extrinsic motivation, and cognitive engagement. This study was conducted in the context of undergraduate educational psychology classes and used a scale to measure student cognitive engagement in a general learning task. Results indicated a positive correlation between students' self-efficacy, intrinsic motivation, and cognitive engagement; conversely, extrinsic motivation was correlated with shallow cognitive engagement with the task. This study is useful in demonstrating the relationship between students' motivation and their level of cognitive processing; students who are efficacious about a task are more likely to demonstrate deeper cognitive engagement with this task. Highly motivated students may also employ more effective metacognitive strategies such as planning how to approach a new learning task, evaluating their progress, and monitoring their comprehension of new material (Pintrich & Schunk, 2002; Pintrich, 2000b).

Expectancy-Value Theory

Expectancy-value theory posits that motivation is a function of an individual's expectancy for success for a given task and the individual's value for the task (Eccles & Wigfield, 1994; Eccles & Wigfield, 2002). This theory grew from the early work of Atkinson (1957) and was developed throughout the 1960's and 1970's (Battle, 1965; Crandall, 1969; Feather, 1982) and is recently associated with the work of Eccles and Wigfield (1994, 2002).

Within this model, expectancies for success and task value are the two primary constructs related to an individual's motivation. Interestingly, these constructs have been studied together and in isolation; research indicates that task value is often predictive of an individual's choices or decisions while expectancies for success are more predictive of performance (Wigfield & Eccles, 2002).

Some researchers distinguish between expectancies for success and ability beliefs (Watt & Richardson, 2007). Expectancies for success refer to individuals' perceptions of how they will perform on an upcoming task. Ability beliefs describe an individual's judgment of their specific ability to perform a given task. However, Wigfield & Eccles (2002) did extensive exploratory and confirmatory factor analyses and did not find a distinction between these two constructs. Consequently, Wigfield and Eccles (2002) combined expectancy for success and ability beliefs into a single construct, expectancy/ability.

In addition to students' expectancies for success (Bandura, 1997), motivation can also be affected by a student's value for the domain or task. Task value is central to the expectancy-value motivational theory (Eccles & Wigfield, 1994). Task value is generally discussed in terms of utility value, intrinsic value, attainment value, and cost (Wigfield & Eccles, 1992, 2002). Utility value refers to the student's perception of how useful a given task or domain is in his or her life. Intrinsic value references the student's enjoyment of the task or domain. Attainment describes the perceived importance of succeeding at a task, while cost refers to the effort needed to complete a task. Task value can be predictive of students' motivation for the given task or, in relation to the current study, science. Studies indicate that intrinsic and utility task value are predictive of students' effort in science classes and course selection (Cole, Bergin, & Whittaker, 2006; Meece, Wigfield, & Eccles, 1990; Wigfield, 1994). In particular, research has highlighted the correlation between students' utility value, or perceived usefulness, for a task or domain and their achievement within that domain (Bong, 2001). Students who perceive a task, course, or domain as useful and applicable to their lives are more likely to perform well in that context and achieve at higher levels. Cole, Bergin, and Whittaker (2008) conducted a study on task value for low stakes tests with a sample of 1005 undergraduate students. Participants in the study took a general academic standardized test and then completed a motivational measure asking them to report on their value for the task (taking the test) and effort during the task. Results indicated a correlation between students' perceived usefulness and importance of the test and students' effort and performance on the test. These findings indicate that students who perceived the test as important and/or useful not only expended more effort on this test but also performed better on the test.

Research also highlights the possible connections between task value and goal orientations (Hidi & Harackiewicz, 2000). For example, a student who holds a mastery orientation for learning science may be more likely to perceive science as useful and enjoyable. Harackiewicz, Barron, Durik, Linnenbrink-Garcia, and Taue (2008) investigated the reciprocity of task value, achievement goals, and performance. Researchers examined these constructs in the context of an undergraduate introductory psychology class; 858 students completed measures of task value and goal orientation at the beginning of the course, at the end, and seven semesters later. Results indicated positive correlations between students' initial interest in the course, goal structures and ultimate performance in the course. Over time, students' interest in the course was predictive of their future course choices. This study demonstrated the relationships among separate motivational constructs of goal orientation and task value; this may indicate common antecedents to these constructs, a concept related to the current study, which focuses on task value, efficacy, and goal orientation.

Self-Efficacy

Though the motivational framework for the current study is grounded in expectancy--value theory, I made the decision to refer to self-efficacy instead of expectancy. This decision was made for several reasons. First, research differs on the exact composition of the expectancy component; some researchers divide this construct into expectancy for success and ability beliefs while others merge these two ideas into one, expectancy/ability beliefs (Wigfield & Eccles, 2002). The current study aims to examine students' judgments regarding their ability to learn science. While expectancy-value theory offers a useful framework for understanding students' task value for science, self-efficacy provides a more solid grounding for studying students' perceptions of their abilities to learn science. In addition, literature specific to science self-efficacy is more abundant and substantial than literature related to expectancy for success in science. Consequently, the current study could better build on previous literature within the field of science education with a focus on the construct of self-efficacy. Additionally, instrumentation decisions necessitated the selection of a measure of self-efficacy for science learning rather than expectancies for success. Considering the developmental level of participants in the current study, these measures of self-efficacy were more appropriate for examining motivational constructs of interest. Selection of instrumentation and refinement of these measures are described in detail in Chapter Three.

Bandura (1977, 1997) noted that self-efficacy can be predictive of an individual's motivation, affect and behavior. In addition, studies have found that self-efficacy is a strong predictor of students' course selections and career choices (Britner & Pajares, 2001; Lau &

Roeser, 2002). Specific to science education, research indicates that students' science self-efficacy, or the confidence students have for learning science, can influence their persistence with challenges, effort for difficult tasks, and their choices of upper-level science courses (Britner & Pajares, 2001; Pajares, 1996).

Studies have also found that students' science self-efficacy is correlated with science achievement (Britner & Pajares, 2001; Britner & Valiante, 2000). In fact, Bandura (1997) postulated that students' self-efficacy for a domain may be a better predictor for their achievement in that specific content area than objective assessments. For example, students who are efficacious about their ability to learn science are more likely to attempt challenging tasks, persist at those tasks, and make positive attributions for both success and failure (Bandura, 1986, 1997). The opposite is true of students with low self-efficacy for learning science.

Bandura (1986, 1997) theorized that several key experiences contribute to an individual's self-efficacy for any given domain. These experiences include mastery experiences, vicarious experiences, social persuasion, and physiological states. Mastery experiences are small successes with tasks that help foster efficacy for completing similar or related tasks in the future. For example, a student who experiences a small success in writing up a portion of a science lab may feel more efficacious for completing science labs in the future. Vicarious experiences are those in which the student observes a similar individual successfully complete a task and consequently experiences an increase in personal efficacy for the same tasks. An African-American science student who observes another African-American science student succeed at a science fair may be more efficacious about his or her own ability to succeed at science fair projects in the future. Social persuasion refers to the role of negative and positive feedback in relation to an individual's ability in facilitating a decrease or increase in efficacy for a related task. A teacher who offers specific, positive feedback about a student's performance on a science task may facilitate an increase in the student's efficacy for completing a similar task in the future. In terms of physiological states, Bandura noted that individuals interpret their internal state as positive or negative. This in turn affects the way that individuals perceive their efficacy for completing a task. For example, a student who experiences an anxious internal state while taking a science test may experience a decrease in efficacy for performing well on future science tests. Conversely, a student who is calm during a science test may experience an increase in efficacy for performing well on other science tests. Bandura (1986, 1997) noted, however, that these four mechanisms work together to influence students' self-efficacy; one experience alone is seldom sufficient for long-term effects on an individual's efficacy for a specific task or domain.

Britner and Pajares (2006) examined the self-efficacy beliefs of 319 middle school science students in relation to Bandura's hypothesized sources of self-efficacy. This study was an early empirical investigation to explore science efficacy in relation to Bandura's sources of self-efficacy. Significant correlations were found between self-efficacy and the following sources of self-efficacy from Bandura's theory: mastery experiences, vicarious experiences, physiological persuasions, and social persuasions. However, mastery experiences were the only significant predictors of students' efficacy for learning science. This study also found science efficacy to be a significant predictor of science achievement. Britner and Pajares concluded that teachers could foster the development of self-efficacy beliefs in middle school students by providing appropriate opportunities for mastery experiences. They noted the importance of challenging, yet manageable tasks that allow students to experience small successes and thereby increase their efficacy for learning science. Britner and Pajares also emphasized the role of teacher scaffolding as students adjust to more demanding tasks and more detailed content at the middle school level.

The findings from this study inform the current study and its focus on self-efficacy in middle grades science. Britner and Pajares reference the role of the teacher in supporting students' self-efficacy for learning science in middle school; the current study investigates interactions between students' self-efficacy for science and interactions with their science teachers.

Self-efficacy is a central concept to the development of students' academic motivation (Bandura, Barbarabelli, & Caprara, 2001; Bandura, 1989). Students with high self-efficacy for a task have confidence in their ability to perform the task effectively. In contrast, low self-efficacy is marked by a lack of confidence in one's abilities to succeed at a given task or domain (Pintrich & Schunk, 2002; Pintrich, 2000b). Studies indicate that self-efficacy is positively correlated with student achievement (DiPerna, Volpe, & Elliott, 2005; DiPerna & Elliott, 1999; Whang & Hancock, 1994). Students who believe that they can perform well in a specific academic domain make healthier attributions for both success and failure, consequently supporting learning strategies that are associated with higher student achievement (Weiner, 1985). Since self-efficacy has been identified as a domain-specific construct (Ormrod, 2006; Stipek, 1988), students may have high self-efficacy for some academic tasks and lower self-efficacy in other areas. For example, students may feel efficacious about their ability to learn mathematical procedures but hold lower self-efficacy beliefs about learning science content. In this current study, students' self-efficacy for science learning was viewed as a primary component in their overall science motivation.

Goal Orientation

Goal orientation refers to students' achievement goals, or "the reasons that students have for doing their academic work" (Pajares, Britner, & Valiante, 2000). These achievement goals are typically described as either performance goal orientations or mastery goal orientations

(Ames, 1992; Dweck, 1986; Pintrich & Schunk, 2002). A performance orientation is typified by a focus on competition, comparison to others, and either displaying competence (performance-approach) or avoiding failure (performance-avoid) (Anderman, Patrick, & Ryan, 2004; Midgley, Kaplan, & Middleton, 2001). In contrast, a mastery orientation is characterized by a focus on personal progress, improvement, and learning for learning's sake. Performance oriented students are more likely to make social comparisons and place value on doing better than other students (Pajares, et al., 2000; Schunk, 1996). Mastery oriented students tend to seek challenges and concern themselves with setting and achieving personal goals (Pajares, et al, 2000; Anderman & Young, 1994). Mastery oriented students tend to make external attributions for failure, persist in the face of academic challenges, and employ more effective cognitive strategies (Schunk, 1996; Anderman & Young, 1994). Conversely, performance oriented students tend to make internal attributions for academic failures, employ less effective cognitive strategies, and lack persistence in academic challenge (Ryan & Pintrich, 1997; Anderman & Young, 1994).

Aspects of the classroom learning environment are also influential in students' individual goal orientations (Church, Elliott, & Gamble, 2001; Midgley, Anderman, & Hicks, 1995). Teachers who promote competition and place a high value on test grades may foster the development of performance goal orientations in their students. Conversely, teachers who value understanding of concepts and emphasize individual effort over grades are more likely to encourage the development of mastery goal orientations in their students (Ames & Archer, 1998; Wolters, 2004). Evaluation practices are especially influential in goal orientations (Ames, 1992; Anderman & Midgley, 1998). As students move into middle and high school, an increased emphasis is placed on normative evaluation, which encourages students to view their performance in comparison to the performances of other students. These normative evaluation practices work to foster performance-oriented goals structures within classes and ultimately in students (Ames, 1992).

Anderman and Midgley (1998) conducted a study of 341 students from their fifth grade year into their sixth grade year. As fifth graders, students reported an emphasis on personal goals as well as higher levels of competence for their academic abilities. As sixth graders, these students reported more emphasis on competition and comparisons with the performance of other students. In addition, students reported lower levels of academic competence in sixth grade. Students also reported less emphasis on personal improvement in sixth grade and an increased focus on individual ability in comparison to other students. Anderman and Midgley (1998) concluded that the classroom environment plays a large role in facilitating the development of mastery and performance goals in students. This finding is relevant to the current study, since teacher factors are influential in these classroom goal structures. Teacher interpersonal behavior can communicate the goals that are valued within the classroom, goals based on personal mastery and improvement or goals focused on demonstration of ability and competition.

Domain-Specific Motivation

Student motivation is domain-specific and can vary across curricular areas (Ormrod, 2006; Stipek, 1988). Students as young as 8 years have demonstrated the ability to differentiate between subject areas in relation to motivational constructs (Anderman, Patrick, & Ryan, 2004). A study by Eccles, Wigfield, Harold, and Blumenfeld (1993) demonstrated that children as young as first-grade could distinguish clearly between their competence and value of varying subject areas, including math, reading, and music. Results from the study, which included students in first, third and fourth grades, indicated that students reported different attitudes dependent on the subject area. This study provided evidence of domain-specific motivation, even in young children.

Other research also indicates that motivation may differ from one subject to another, especially in early adolescents (Bong, 2001; Stodolsky & Grossman, 1995). As students move to secondary levels where subject areas are more departmentalized and integration of subject is less common than in elementary grades, motivational constructs may differ by domain, rendering general academic measures ineffective in differentiating between subject areas (Rudolph, Lambert, Clark, & Kurlakowsky, 2001). Bong (2001) conducted a study of middle and high school students in Korea (N=424) which investigated the subject-specificity of task value, self-efficacy, and goal orientations. This study examined these constructs in relation to the following subject areas: Korean, English, Math, and Science. Results indicated a strong subject-specificity for self-efficacy, task value, and goal orientations; students displayed distinct differences in these motivational constructs dependent on the academic domain. Of these constructs, students differed most between subjects in their self-efficacy and task value; goal orientations were less distinctive across subjects. This study demonstrates the need to study domain-specific motivation, especially in terms of efficacy and value. General measures of student motivation are not adequate to capture the subject-specificity of these constructs; students display distinct motivational profiles for different domains.

Teacher-Student Interactions and Science Attitudes

The majority of research on teacher interpersonal behavior and students' science attitudes has been conducted within secondary settings, mostly grade nine and higher (Wubbels & Brekelmans, 2005). There have been attempts to extend this research into the primary grades (den Brok, Fisher, & Scott, 2005), but these studies are outnumbered by those conducted with high school students. The middle grades have been largely unrepresented in this line of research. The primary instrument that is used to measure students' perceptions of teacher interpersonal behavior is the Quality of Teacher Interactions survey (Wubbels & Brekelmans, 1998; Wubbels & Levy, 1993). This instrument, described in detail in Chapter Three, is written on a secondary level, presenting problems with adapting it to younger children.

While this line of research originated in the Netherlands, it has become a cross-cultural endeavor, with studies taking place in Australia, the US, Taiwan, Korea, India, Canada, Slovenia, Israel, Turkey, and Singapore (Wubbels & Brekelmans, 2005). Because of this multi-national focus, this line of research presents the unique opportunity to study not only trends within a culture, but also cross-cultural trends in teacher interpersonal behavior and related student outcomes. Much of the research has focused on student attitudes and how these are affected by teacher interpersonal behavior. Science has become an area of increased interest in this field; cross-cultural studies have focused on aspects of teacher interpersonal behavior that affect students' attitudes toward science (denBrok, Levy, Brekelmans, & Wubbels, 2005; den Brok, Fisher, & Koul, 2005; den Brok, Fisher, & Scott, 2005).

den Brok, Fisher, and Koul (2005) conducted a study of secondary students' perceptions of teacher interpersonal behavior and students' attitudes toward science in Kashmir, India. Teacher interpersonal behavior was measured using the Quality of Teacher Interaction (QTI) survey and science attitudes were measured using the Test of Science Related Attitudes (TOSRA). It is important to note that the QTI was translated into Hindi for this study and refinement of this new translation was limited. Thus, some concerns arise about the validity of the translation, especially in consideration of the cultural differences between India and the original version, created in Australia in English. This study attempted to control for other aspects of the learning environment, such as student cohesiveness and perceived equity. Results indicated that both teacher proximity and teacher influence were strongly associated with students' attitudes towards science, even after controlling for covariates. Students who perceived their teacher as in control (influence) and cooperative (proximity) also reported more positive attitudes for science. This study supported findings from research in other cultures that also found teachers' interpersonal behavior to be associated with students' science attitudes. Within this study, however, researchers argued for the existence of cross-cultural themes in students' science attitudes and teacher interpersonal behavior. However, this generalization seems premature since this study was the first of its kind in India and focused on a sample from one region of India.

In another international study of teachers' interpersonal behavior and students' science attitudes, den Brok, Fisher, and Scott (2005) investigated these constructs in primary schools in Brunei. This study was the first of its kind in Brunei and was unique from previous related research because of its focus on primary grades. Results from this study indicated a positive association between students' enjoyment of science and teacher proximity and influence. The QTI was translated into Malay for its use in Brunei; however, a simplified version of the instrument was also used in order to make the language more appropriate for a younger set of participants. Previously, the QTI had been used only in a secondary setting. In addition, the length of the original QTI (48 items) was not shortened for the simplified version. A lengthy instrument is not developmentally appropriate for young children, as fatigue and attention factors can affect survey results.

Motivation in Middle Grades

Middle school is often a challenging time for students because of a variety of developmental and social factors. Many students experience changes in cognitive and motivational factors during middle grades (Pajares, Britner, & Valiante, 2000; Singh, Granville, & Dika, 2002; Rudolph, et al., 2001). In middle grades, the school and classroom climate is often dramatically different than what it was during elementary school (Midgley, Anderman, & Hicks, 1995). Middle school students generally experience larger class sizes, multiple teachers, increased ability grouping, decreased parental involvement, and larger school buildings (Eccles & Wigfield, 1994). In addition, teachers at the middle school level often exhibit more controlling behaviors within the classroom context, providing students with fewer choices and decreased opportunities to participate in decision-making processes within the classroom (Rudolph, et al., 2001; Eccles & Midgley, 1989). Ironically, this shift in classroom control structures occurs at the developmental stage of early adolescence, a time when individuals have an increased need for autonomy (Eccles & Midgley, 1989).

In addition to changes in school and classroom climate, teacher factors are also different in the middle school years. Studies indicate that middle school teachers tend to exhibit less nurturing behaviors than elementary teachers (Barber & Olsen, 2004; Eccles & Midgley, 1989). With increased class sizes, middle school students may also perceive teacher-student relationships to be less personal and more distant, leading students to perceive less support from their teachers (Barber & Olsen, 2004). A study by Eccles, Wigfield, Midgley, Reuman, MacIver, and Feldlaufer (1993) found relationships between aspects of the middle school environment and lower student motivation as students progressed to the middle grades. The study attributed this decline in student motivation to various classroom and teacher factors, including an increase in teacher control and a decrease in decision-making opportunities for students in middle school in comparison to elementary grades.

Teachers in the middle grades also tend to place increasing emphasis on student academic performance, especially on standardized tests. This emphasis encourages the formation of performance oriented goals structures, with an increased focus on competition and a decreased value of mastery goals (Alspaugh, 1998). Evaluations that focus on aspects of student comparison facilitate the development of performance orientations in students (Ames, 1992). Anderman and Midgley (1998) noted differences in the way that students described their classrooms from fifth to sixth grade. Students reported an emphasis on personal improvement in fifth grade and an increased emphasis on competition in sixth grade.

Students may be especially likely to experience a decrease in their science motivation during middle grades (Pajares, Britner, & Valiante, 2000; Singh, Granville, & Dika, 2002), exhibiting a subsequent drop in achievement. This decline in motivation and achievement is critical, as middle school performance and attitudes influence students' academic trajectories, high school course selections, and, ultimately, career choices (Singh, Granville, & Dika, 2002). Motivational patterns in early adolescence are fairly stable and persist into high school and beyond (Eccles & Midgley, 1989). With the lingering effects of middle school attitudinal factors and achievement, this drop during middle school in the area of science is a significant cause for concern.

Summary

This chapter has presented a review of literature in the following areas: (1) factors affecting teacher-student interactions (2) dimensions of teacher-student interactions (3) motivational theories (expectancy-value, self-efficacy, and goal orientation) (4) domain-specific motivation (5) teacher-student interactions and students' science attitudes and (6) motivation during the middle grades. The constructs discussed in Chapter Two narrow to define the purpose of this study. This study examined the relationship between sixth grade students' perceptions of teacher-student interactions and related science motivation; these students were in their first year of middle school. Chapter Three details the research methodology for this study and defines the procedures for data collection and analysis.

Chapter Three: Method and Procedures

Study Overview

This purpose of this study was to examine the relationship between students' perceptions of teacher-student interactions in middle school science and their related motivation for learning science. This sequential explanatory mixed methods study consisted of a qualitative and quantitative phase and was guided by the following research questions:

- (Overarching) What relationship exists between middle school science students' perceptions of teacher-student interactions and their motivation for learning science?
- (Quantitative phase) To what degree are students' perceptions of teacher-student interactions predictive of their motivation for learning science science?
- (Qualitative phase) How do middle school science students' perceptions of teacher-student interactions affect their task value, self-efficacy, and goal orientation for learning science?

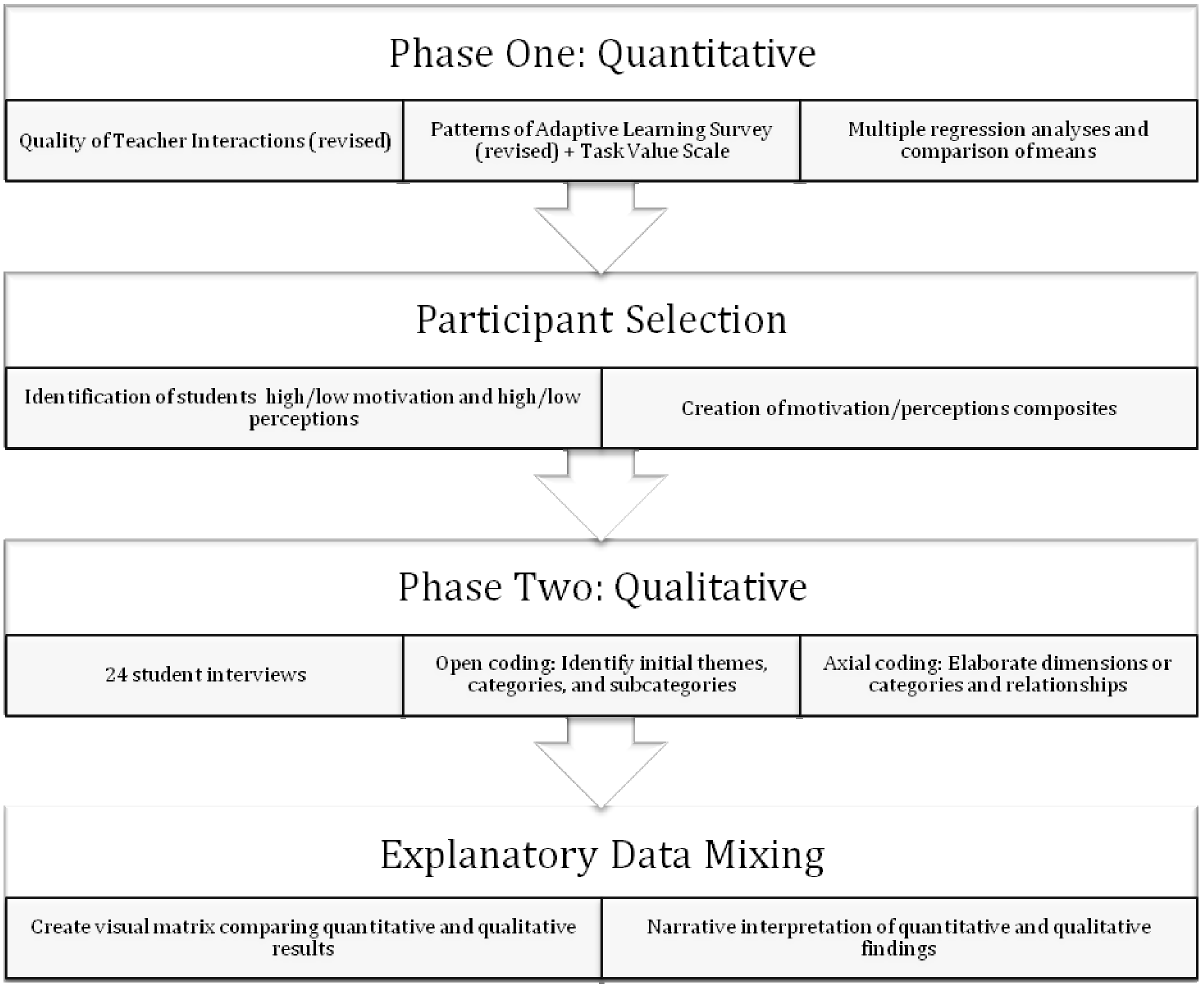
Study Design

Mixed Methods Design: Sequential Explanatory Model

This mixed methods study followed a sequential explanatory model (Cresswell & Plano-Clark, 2007). Specifically, a participant selection model was the basis of the design. In this model, quantitative and qualitative data are collected in two phases, with quantitative data in the first phase informing the selection of participants for the second qualitative phase. The second qualitative phase helps to clarify and explain results from the first quantitative phase. In this design, data mixing occurs between Phase One and Two (participant selection) and at the interpretation level (explanatory) after quantitative and qualitative data are analyzed separately. Figure 3.1 present a visual schematic for the design of this study.

Figure 3.1

Sequential Explanatory Mixed Methods Design



During the quantitative component, students' perceptions of teacher-student interactions were measured using the Quality of Teacher Interactions instrument (QTI) (Wubbels & Levy, 1991). Student efficacy for learning science and goal orientation were measured using scales from the Patterns of Adaptive Learning Survey (Middleton & Midgley, 1997). A science-specific task value scale was also constructed in conjunction with a measurement expert to address the specific constructs of interest in the present study. Revisions to the QTI and PALS scales were also necessary due to the developmental level of sixth grade students and because of a British-

English component to the QTI. These scales were piloted with a sixth-grade science class prior to use in the current study. These revisions and the pilot are discussed in detail in this chapter.

A quantitative statistical analysis examined the relationship between students' science motivation and their perceptions of teacher-student interactions in their science classroom. A participant selection phase then followed; quantitative data were used to identify students who reported specific composites of motivation and perceptions of teacher-student interactions. This selection process is detailed in this chapter. The qualitative component followed a quasi-grounded theory design, consisting of 24 student interviews to provide a more in-depth analysis of factors influencing students' science motivation and teacher-student interactions. These interviews were transcribed and analyzed using the constant comparison method (Strauss & Corbin, 1998) in order to describe the role of teacher-student interactions in students' science motivation and dimensions of these constructs. After quantitative and qualitative data sources were analyzed separated, they were mixed again at the interpretation level. This phase of data analysis examined the extent to which quantitative and qualitative data sources confirmed, converged, or differed in regards to the phenomenon of the present study (Creswell & Plano-Clark, 2007). This data mixing allowed for a thorough cross-comparison of findings from survey results and interview data and provided a more comprehensive view of the relationship between teacher-student interactions and science motivation and dimensions of these constructs.

Rationale for Method

This sequential explanatory method was selected because of the need for both quantitative and qualitative data to best understand the current problem. A mixed methods design allowed for the collection of different yet complementary data on the topic of teacher-student interactions and related science motivation (Creswell & Plano-Clark, 2007). A participant selection model allowed for the selection of participants for qualitative interviews according to specific criteria necessary to gain insight into the effect of teacher-student interactions on students' motivation in science. The explanatory design also provides for a direct comparison of quantitative statistical results with qualitative findings in order to validate, corroborate, or expand findings from the quantitative phase. In addition, this design facilitated the development of valid, well-substantiated conclusions regarding teacher-student interactions and student motivation in middle school science as well as an in-depth analysis of dimensions of these constructs (Cresswell & Plano Clark, 2007).

Participants

Participants for this study were 223 sixth grade science students from a middle school academy in a school district in the Southeast United States. This middle school academy, with a student enrollment of 1,069 students, is situated in a suburban area of a metropolitan area. 34.7% of the students in this school qualify for free and reduced meal status. The participants were students of three science teachers and were members of 12 sixth-grade science classes in this middle school academy. Table 3.1 provides demographics for these participants, gender and ethnicity. Prior to recruiting student participants, permission was secured from the following parties: Institutional Review Board, Director of Research and Accountablilty with the school district, middle school academy principal, and participating teachers. Student particpants for this study were contacted through their classroom teacher and provided with a parental consent form (Appendix E) and a student assent form (Appendix F). All aspects of participation in the research study were explained in detail to both students and parents and times for survey administration and interviews were coordinated with the classroom teacher in order to protect instructional time.

Table 3.1

Demographics for Survey Participants (N=223)

Gender: Female	Gender: Male	Ethnicity: African American	Ethnicity: Caucasian	Ethnicity: Hispanic	Ethnicity: Asian American	Ethnicity: Other
112	111	64	126	14	12	7

Instrumentation

Questionnaire on Teacher Interaction

The Questionnaire on Teacher Interaction (QTI) was developed by Wubbels and Brekelmans in the Netherlands in order to measure the quality of teacher-student interactions in the classroom (Wubbels & Brekelmans, 1998; Wubbels & Levy, 1993). The instrument was first piloted in an international setting in Singapore by Goh (Goh & Fraser, 1998). The instrument has since been cross-validated for use in a variety of international settings. Table 3.2 displays the reliabilities of the QTI scales from research in the US, Australia, and the Netherlands.

The QTI was designed to assess students' perceptions of teacher-student interactions and includes items which describe students' interactions with teachers on a variety of dimensions. It is based on a theoretical model of proximity (cooperation vs. opposition) and influence (dominance vs. submission) (Leary, 1957). The 48 items of the QTI are organized into the following eight scales: Leadership, Helpful/Friendly, Understanding, Student Freedom, Understanding, Dissatisfied, Admonishing, and Strict. Scores from these scales can be used to create a visual representation of teacher-student classroom interactions. The Model for Interpersonal Teacher Behavior (Figure 2.1), which is divided into eight equal parts, represents the eight scales of the QTI. Students responded to the items in the QTI with a 5-point Likert scale which indicated whether the given statements described their teacher; the scale ranges from Never (0) to Always (4). These scores were then used to create a score for each scale; the higher the scale score, the more the student perceives that the teacher displays the characteristics of that scale. The scale scores are independent of each other and are not combined to render a total score. However, scale scores can be calculated for individual student or can be combined to find a class mean. The QTI is provided in its entirety in Appendix A.

Table 3.2

Reliability (Cronbach's Alpha) for QTI Scales for Students in Three Countries

QTI Scales	USA	Australia	Netherlands
Leadership	.80	.83	.83
Helpful/friendly	.88	.85	.90
Understanding	.88	.82	.90
Student responsibility/freedom	.76	.68	.74
Uncertain	.79	.78	.79
Dissatisfied	.83	.78	.86
Admonishing	.84	.80	.81
Strict	.80	.72	.78

Revisions to QTI

Revisions to this instrument were necessary for several reasons: (1) The English version of the QTI is written using British English and is therefore difficult for students in the United States to understand. This language difference could affect the reliability and validity of survey items if their meaning is not understood by students. For example, (2) The QTI has been administered primarily in secondary settings and is written at a higher reading level than is appropriate for sixth grade students. (3) The length of the instrument (48 items) may be too lengthy to yield reliable and valid results with young children. With an instrument of this length, a fatigue factor can be an issue with children in early middle grades. In an initial pre-study pilot of the original 48-item instrument, students were not able to maintain attention over the course of the lengthy instrument. Coupled with the concerns listed above, this experience motivated the revisions to the QTI that are described below.

Fraser and Wahberg (2005) also echoed similar concerns for the use of the QTI with young students:

> For some younger respondents, however, the readability of some questionnaire items can be a challenge. Also, because the QTI's underlying theoretical foundation necessitates the use of all eight scales, some researchers and practitioners who are interested in assessing teacher–student interaction would like to do so with a shorter questionnaire with fewer scales and items (p.11).

Revisions to the QTI were conducted under the guidance of a measurement expert. The primary goals of this revision were the following: (1) Rephrase items from British English to American English (2) Shorten the 48-item instrument, while retaining the constructs of the original QTI (3) Rephrase items to reflect an appropriate reading level for sixth graders, while retaining the constructs of the original QTI.

First in this revision process, I contacted the researchers who were integral in the development of the QTI. I expressed my concerns about the language, length, and reading level and they did agree that these were valid concerns. Though they recommended a shortened version of the QTI, the problems with British phrasing and reading level were still present. The creators of this instrument did not object to my attempts to adapt the measure to a US, middle grades audience. Since the QTI has not been used extensively with either a US population or with students in middle grades, these revisions were deemed necessary and appropriate.

I worked with a measurement expert who is also an educational psychologist and familiar with the constructs that I needed to retain in the revisions. We went through each item and rephrased the British English into phrases that would be more comprehensible to American students. In addition, we selected three items from each original six-item scale of the QTI in order to shorten the instrument. We selected items that were the most representative of the constructs that each scale was designed to measure. In addition, we rephrased any items that were written at an advanced reading level. Since the study included students from all ability levels in sixth grade, we felt it was important to reflect terminology that did not exceed the fifth grade level. Readability for the revised QTI assessed using the Flesch-Kincaid Grade Level test and was determined to be 2.7 (equivalent to second grade, seven months).

We also decided that the numerical Likert scale was too ambiguous for young students; in other words, it would be difficult for sixth-grade student to differentiate between a 0, 1, 2, 3, and 4 with the only descriptors being 0=Never and 4=Always. Consequently, we retained the 5-point scale, but rewrote numerical ratings with descriptors for each level. The resulting scale was as follows: Never, Not Often, Sometimes, Often, and Always.

An expert in the field of teacher-student interactions examined the revised instrument for face validity. She assessed the revised measure as a valid measure of students' perceptions of teacher interpersonal behavior and did not recommend major changes to the revisions. She felt that the original constructs from the QTI were well-represented in the scales of the revised instrument.

Next, the revised QTI was piloted with a class of sixth-grade science students (N=25). Reliability for scales in the revised QTI are presented in Table 3.3. Reliability for each scale was estimated by computing the Cronbach's Alpha. Further, an examination of "Cronbach's Alpha if Item Deleted" suggested that all items within these scales should be retained. The revised QTI is located in Appendix D.

Table 3.3

Reliability (Cronbach's Alpha) for Revised QTI Scales: Pilot

Revised QTI scale	Reliability Coefficient
Leadership	.67
Helping/Friendly	.70
Understanding	.77
Strict	.75
Admonishing	.60
Dissatisfied	.72

Student Responsibility	.62
Uncertain	.57

Patterns of Adaptive Learning Survey

The Patterns of Adaptive Learning Survey was developed by Middleton and Midgley (1997) and refined to reflect its current form. The PALS is based on goal orientation theory and was designed to measure relationships between the learning environment and dimensions of student motivation and affect. In its entirety, the measure includes both student scales and teacher scales. The student instrument includes the following sub-scales: (1) personal achievement goal orientations (2) perceptions of teacher's goals (3) perceptions of the classroom goal structure (4) achievement-related beliefs, attitudes, and strategies and (5) perceptions of parents and home life (Middleton & Midgley, 1997). The PALS student instrument is based on a 5-point Likert scale ranging from 1 (not true at all) to 5 (very true). The teacher instrument includes the following sub-scales: (1) perceptions of the goals structure in the school (2) goal-related approaches to instruction and (3) efficacy for teaching. The PALS teacher instrument is also based on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Reliability coefficients associated with all scales of the student and teacher versions of the PALS are listed in Table 3.4. These values are derived from research with 5th and 6th grade students in nine school districts in the Midwest (N= 1,755) (Midgley, et.al., 1998).

Table 3.4

Reliability (Cronbach's Alpha) for PALS Scales in Studies with 5th and 6th Grade Students (N=1,755)

PALS Scales	Reliability
Mastery Goal Orientation	.85
Performance-Approach Orientation	.89
Performance-Avoid Orientation	.74
Academic Efficacy	.78
Relevance for School for Future Success	.83

Revisions of PALS Scales

Revisions to the PALS Scales were also completed under the guidance of a measurement expert familiar with the motivational constructs the scales were designed to measure. Two primary concerns motivated the need for these revisions: (1) The length of the instrument (2) Confusing phrasing using double negatives. In order to control for a fatigue effect with young students, it was necessary to trim the length of these scales, especially because it and the QTI were to be used together. In addition, we felt that the double negatives in many of the items would be confusing, possibly decreasing the reliability and validity of the measure.

First, we examined the reliability of each individual item from each scale; these reliabilities were available in the *Manual for the Patterns of Adaptive Learning Survey (PALS)* (Midgley, et.al., 2000). We retained items that had the highest individual reliabilities, resulting in three-item scales in the revised measure. Through this process, we shortened the original PALS scales, which each contain six items. Next, we rephrased items including double negatives to increase clarity. For example, one item originally read as follows: “One of my goals is to keep others from thinking I’m not smart in science class.” This item was rephrased to read: “One of my goals it to keep others from thinking I’m stupid in science class.”

In addition, we made changes to the Likert scale of the PALS instrument to make it more appropriate for the middle grades. The original 5-point Likert scale contains numbers from 1 to 5 with descriptors of “Not at all true=1,” “Sometime true=3,” and “Very true=5.” We felt that this scale was too ambiguous for young students; they would have difficulty differentiating between ratings with and without descriptors. We decided to re-write the Likert scale using a 6-point scale with the following descriptors: Strongly disagree, Disagree, Somewhat disagree, Somewhat agree, Agree, and Strongly agree. The use of a 6-point Likert scale also removed the middle, neutral answer.

In addition to these revisions, we also created a 3-item measure of task value, based on the dimensions of utility and importance of science. This scale was developed based on literature related to expectancy-value, of which task value is a central construct. This scale was developed in conjunction with a measurement expert and educational psychologist familiar with the theoretical construct of task value. Readability for the revised PALS scales and the task value scale was assessed using the Flesch-Kincaid Grade Level test and was determined to be 3.4 (third grade, four months).

A motivational expert examined the revisions to the PALS scales as well as the task value scale for face validity. She assessed the revisions as appropriate and the task value scale as a valid measure of task value for science. Her appraisal was that the revisions did not stray from the original intent of the PALS measures, and therefore did not recommend further revisions.

Next, the revised PALS and task value scale was piloted with a class of sixth-grade science students (N=25). Reliability for scales in the revised PALS and task value scale are presented in Table 3.5. Reliability for each scale was estimated by computing the Cronbach's Alpha. Further, an examination of "Cronbach's Alpha if Item Deleted" suggested that all items within these scales should be retained. The revised motivational instrument is located in Appendix C.

Table 3.5

Reliability coefficients (Cronbach's Alpha) for revised PALS Scales and Task Value Scale: Pilot

Revised PALS scale	Reliability Coefficient
Mastery Orientation	.67
Performance Orientation	.61
Efficacy for Learning Science	.71
Task Value for Learning Science	.85

Data Collection and Analysis

The current study followed a sequential explanatory/participant selection mixed methods design (Creswell & Plano Clark, 2007). This study consisted of two phases; a quantitative phase was followed by a qualitative phase with a period of participant selection occurring between these phases. A detailed description of each phase is provided in this section.

Quantitative Phase

Data Collection

Student participants completed two measures during the quantitative phase of this study. Surveys were administered in the students' science class and each item was read aloud to control for reading level. The first instrument was intended to measure students' perceptions of teacher-student interactions in the classroom. The QTI is a 48-item instrument designed to measure students' perceptions of teacher-student interactions. The QTI consists of the following eight scales: Leadership, Helpful/Friendly, Understanding, Student Freedom, Understanding, Dissatisfied, Admonishing, and Strict. A complete discussion of psychometric properties of the QTI and scoring procedures can be found in the *Instrumentation* section of this chapter. For this study, a revised version of the Questionnaire on Teacher Interaction (QTI) (Wubbels & Brekelmans, 1991) was administered to students in their science classes. Revisions of this instrument are also described in the Instrumentation section of this chapter. The revised instrument was piloted with sixth-grade science class prior to conducting Phase One of this study. Results of this pilot are presented in the Instrumentation section.

Students also complete three scales of the Patterns of Adaptive Learning Survey (Middleton & Midgley, 1997). The PALS is designed to measure student attitudes for academic tasks and domains. The following scales from the complete PALS were administered in the present study: two Goal Orientation scales and the Academic Efficacy Scale. Each scale was adapted to be science-specific. The original PALS scales were shortened in order to control for fatigue factors that are a concern with young students. Procedures for eliminating items from the PALS scales are described in detail in the Instrumentation section. In addition, a task value scale was written in conjunction with a measurement expert; this scale reflected the construct of task value which was a focus for the current study. The revised PALS scales and the task value scale were piloted with a sixth-grade science class before conducting Phase One of this study. Results from the pilot study are presented previously in the Instrumentation section of this chapter.

Data Analysis

Initial Screening of Data Set. After quantitative survey data were collected, a general pre-analysis of the data was conducted. Surveys were first screened for incomplete items; five surveys that had not been completed were dropped from the sample. Data were then entered into SPSS for further analysis. Data first were analyzed for the following assumptions: (1) normality (2) linearity and (3) homoscedasticity. Normality was examined by normal probability plots (Q-Q Plot) for scale variables. This assumption was met. Linearity was examined by analyzing scatterplots of each dependent variable (from PALS and task value scales) with each independent variable (from QTI scales) and then plotting the fit line and then plotting a loess line. The assumption of linearity was met. Homoscedasticity was examined by running regressions and calculating the Mahalanobis distance. This assumption was also met. Descriptives including means, standard deviations, and variances were also calculated for all variables.

Factor Analysis. An exploratory factor analysis was then conducted with the following measures: (1) revised QTI scales (2) revised PALS scales and Task Value scale. An exploratory factor analysis was selected because the revision of the scales necessitated an examination of the loadings of each item; because of the revision of items, a confirmatory factor analysis based on original QTI scales and PALS scales was not appropriate. An examination of scree plots and Eigenvalues revealed an interpretable factor solution for each measure. Reliability coefficients were also calculated for each scale developed from the factor analysis.

These factor solutions were then used to calculate variables for student motivation in science and student perceptions of teacher interpersonal behavior. The following independent variables were calculated for each student: (1) perceptions of teacher's leadership behavior (2) perceptions of teacher's helpful/friendly behavior (3) perceptions of teacher's understanding behavior (4) perceptions of teacher's strict behavior (5) perceptions of teacher's admonishing behavior (6) perceptions of teacher's dissatisfied behavior (7) perceptions of teacher's behavior in providing student responsibility. The following dependent variables were calculated for each student: (1) efficacy for learning science (2) task value for learning science (3) performance orientation for learning science (4) mastery orientation for learning science.

Multiple Regressions. Multiple regression analyses were conducted with each of the four dependent variables (mastery orientation, performance orientation, efficacy for learning science and task value for learning science.) For each dependent variable, a regression analysis was conducted using the seven-scale model from the QTI which was refined through the factor analysis described previously. Bivariate and partial and bivariate correlations were also calculated for each test.

Analysis of Variance. ANOVAs (Analysis of Variance) were also conducted to compare means between gender, ethnic groups, and teacher groups. Post-hoc tests were also conducted for ethnicity and teacher groups since more than two levels were represented in these variables.

Participant Selection

Following a sequential explanatory participant design, quantitative data from Phase One informed participant selection for the qualitative component, Phase Two. In order to further examine the interaction between motivation and student perceptions, quantitative data were examined to identify student participants who reported specified composites of motivation and perceptions of teacher behaviors. The decision to examine high and low extremes of these variables stemmed from a focus on understanding students perceptions relating to higher and lower motivational profiles.

A summative score was calculated for student perceptions of teacher cooperative behaviors using the reported student scores for the following scales: helpful/friendly behavior, understanding behaviors, leadership behaviors. A summative score for motivation was also calculated, using the student reported measures for value and efficacy for learning science. This summative score yielded a motivation variable which became the basis for assigning a motivational profile to each student participant. Summative scores were calculated (motivation and teacher cooperative behaviors) and then divided into quartiles to identify high and low extremes for each variable. Then students were divided into the following categories: high motivation/high perceptions of cooperative behaviors, low motivation/low perceptions of cooperative behaviors, high motivation/low perceptions of cooperative behaviors, low motivation/high perceptions of cooperative behaviors. A complete discussion of the procedures for participant selection is provided in Chapter Four.

Qualitative Phase

Data Collection

The data for the qualitative phase of this study consisted of 24 student interviews. Since data collection in the qualitative phase is independent of the quantitative phase in this participant selection design, participant selection for student interviews was based on students' survey results. A semi-structured interview protocol (Appendix G) was developed by drawing from constructs in the literature on students' perceptions of teacher-student interactions and subject-specific motivation and from findings from the quantitative phase of the study. Teacher cooperative behaviors and oppositional behaviors emerged as predictive of students' efficacy for learning science, task value for learning science, and mastery orientation for learning science. The semi-structured interview protocol was constructed to reflect these constructs and relationships; this protocol design allowed for an in-depth look at constructs that were significant from the quantitative phase. Student interviews ranged in length from 15-35 minutes and were conducted in the school media center at a time that did not compromise the students' instructional time in the classroom. These interviews were recorded digitally and then transferred to a computer for transcription.

The school district in which this study was conducted did not allow individual student interviews in order to protect the interests of the child and parental concerns. Consequently, student interviews were conducted in student pairs. However, students were intentionally paired with a student from their science class with a similar composite of motivation and perceptions of teacher interactions. This was done in order to minimize peer effects that could occur if students with very different perceptions of teacher interpersonal behavior or differing levels of motivation were interviewed together.

Data Analysis

Interviews were uploaded to NVIVO qualitative analysis software and dimensions of each case were specified. These dimensions were drawn from the quantitative phase of the study for each participant. The dimensions that were defined for each participant on NVIVO included the following: gender, ethnicity, motivation (high or low), and perceptions of teacher cooperative behavior (high or low), motivation/perceptions composite (high/high, low/low, high/low, or low/high). Data analysis was performed in accordance with Strauss and Corbin (1998). Interview data were analyzed using the constant comparative method, or the continual comparison of data. Using this method of analysis, data were analyzed as they were collected; subsequent data were then compared to the emergent themes. These initial themes were then compared to successive interview data as categories and subcategories were refined. The four steps of the constant comparative method utilized in this analysis are open coding, (identification of initial themes, categories, and subcategories) and axial coding (elaboration of dimensions of categories and relationships between categories).

Open coding. In the first step of data analysis, a preliminary read-through of each transcription was conducted to gain a comprehensive sense of the data. Then a period of open coding began. The data from each interview were examined and coded on NVIVO, revealing initial concepts relating to the students' perceptions of teacher-student interactions and related science motivation. In constant comparative fashion, these emerging concepts were then compared to previous interview data before conducting additional interviews. During this phase of analysis, initial concepts were identified and related concepts were grouped to create categories.

Several categories were broken down into subcategories. The categories and subcategories drawn from the data during open coding became the basis for interpretation (Strauss & Corbin, 1998), as data were further analyzed and relationships were developed between motivation and student perceptions of teacher interpersonal behavior.

Axial coding. In the next phase of data analysis, axial coding, relationships between categories and subcategories were identified and properties and dimensions of the categories were elaborated. Crosscuts, which are visual representations of relationships between categories, were developed in order to analyze the interactions between aspects of students' perceptions of classroom interactions and science motivation. These crosscuts also allowed for an examination of relationships between categories on a dimensional level, thereby relating the structures of teacher-student interactions with students' motivation in science. Relationships were also analyzed within specific motivation/perception composites.

Data Mixing at the Interpretation Level

In this sequential explanatory/ participant selection design, data sources are mixed between phases and then again at the interpretation level. Creswell and Plano Clark (2007) established the following guiding questions for merging quantitative and qualitative data sets in concurrent triangulation designs: "To what extent do the quantitative and qualitative data converge? How and why? To what extent do the same types of data confirm each other? To what extent do the open-ended themes support the survey results? What similarities and differences exist across levels of analyses?" (Creswell & Plano-Clark, 2007, p. 137). Quantitative and qualitative data may also be merged by creating a matrix to represent findings or through a narrative discussion. A matrix was created to represent the mixing of quantitative and qualitative data and the findings from this process; this matrix is presented in Chapter Five.

Summary

This chapter has detailed the method for this study, along with data collection and analysis procedures, and instrumentation. Chapter Four reports results from this study in the following format: (1) Phase One: Quantitative Results (2) Participant Selection Procedures (3) Phase Two: Qualitative Results. Chapter Five provides a comprehensive interpretation of these results, including a matrix to detail the mixing of quantitative and qualitative results from this study. Theoretical implications, implications for K-12 education and science teacher education, limitations, and future research directions are also discussed in Chapter Five.

Chapter Four: Results

This study examined the relationship between students' perceptions of teacher-student interactions in the middle school science classroom and students' related science motivation. The results of this study are reported in relation to the following research questions:

- (Overarching) What relationship exists between middle school science students' perceptions of teacher-student interactions and their motivation for learning science?
- (Quantitative phase) To what degree are students' perceptions of teacher-student interactions predictive of their motivation for learning science?
- (Qualitative phase) How do middle school science students 'perceptions of teacher-student interactions affect their task value, self-efficacy, and goal orientation for learning science?

In reporting results relating to these research question, this chapter is organized into the following sections: (1) quantitative results (2) participant selection for the qualitative component using quantitative results, and (2) qualitative analysis and results.

Quantitative Results

Preliminary Data Analysis

Data first were analyzed for the following assumptions: (1) normality (2) linearity and (3) homoscedasticity. Normality was examined by normal probability plots (Q-Q Plot) for scale variables. This assumption was met. Linearity was examined by analyzing scatterplots of each dependent variable with each independent variable and then plotting the fit line and then plotting a loess line. The assumption of linearity was met. Homoscedasticity was examined by running regressions and calculating the Mahalanobis distance. This assumption was also met.

Validity of Measures

The validity of the revised Patterns of Adaptive Learning Survey (PALS), Task Value scale, and the Quality of Teacher Interactions (QTI) were evaluated by conducting factor analysis for these measures. This analysis specifically examined the manner in which constructs were delineated within each measure in relation to the pre-determined scales of the measures. The results of these factor analyses are reported below.

Factor Analysis: Patterns of Adaptive Learning Survey and Task Value Scale. The dimensionality of the 15 items from the Patterns of Adaptive Learning Survey (PALS) and Task Value Scale was analyzed using principle components factor analysis. A varimax rotation yielded three factors with Eigenvaules greater than one, which yielded a factor solution which contradicted the pre-determined scales specified by the PALS instrument. Factor loadings are presented in Table 4.1. In this three factor solution, no items loaded on more than one factor. Factor One (which accounted for 24% of item variance) was defined by six of the scale items. These items were related to constructs of mastery orientation and value for science. On a closer analysis of item content, I determined that these six items were partially representative of the concept of value for science and partially representative of the concept of mastery orientation, so Factor One was labeled Intrinsic Value for Science. However, for the purposes of further data analysis, I used two subfactors as the primary units of analysis: Value for Science and Mastery Orientation. This decision was made in order to retain the original form of the PALS instrument while also acknowledging the factor structure of the current data set. Factor Two (which accounted for an additional 22% of item variance) was defined by five of the scale items and was labeled *Performance Orientation*. This differs from the original grouping of the PALS items, since they are generally viewed in terms of performance-approach orientation and performance-avoid orientation. However, this factor analysis demonstrated that the current data do not discriminate adequately between these two dimensions of performance orientation. Therefore, I decided to retain this factor as a single construct: performance orientation. The third Factor was defined by four of the scale items, accounted for 9% of item variance, and was labeled *Efficacy for Learning Science.*

Table 4.1

Factor Loadings for Revised PALS Items and Task Value Items

Item	Factor 1	Factor 2	Factor 3
It's important to me that I learn a lot of new things in science this year.	.711		
Learning science is important	.805		
I want to master a lot of new skills in science this year	.703		
Science in an important subject	.842		
It's important to me that I clearly understand my science class work.	.514		
It is important for me to learn science	.830		
I want to keep others from thinking I'm not smart in science class.		.613	
It's important to me that I look smart compared to others in my class.		.772	
I don't want others to think I have trouble doing class work in science.		.834	
It's important to me that other students in my science class think I am good at my class work.		.819	
It's important to me to avoid looking stupid in class.		.792	
I can figure out how to do difficult class work in science.			.757
I want to show others that science class work is easy for me.			.586
Even if the work is hard, I can learn it.			.707
I can master the skills taught in science this year.			.697
Eigenvalue	4.88	2.93	1.35
% of variance explained	24.3	21.8	9.00

Factor Analysis: Quality of Teacher Interactions. The dimensionality of the 22 items from the Quality of Teacher Interactions (QTI) scale was analyzed using principle components factor analysis. A varimax rotation yielded three factors with Eigenvaules greater than one. No items loaded on more than one factor. Factor loadings are presented in Table 4.2. Factor One (which accounted for 42% of item variance) was defined by 16 of the scale items. Because these items were related to varying student perceptions of teacher behavior, Factor One was labeled *Student Perceptions of Teacher Behavior*. Factor Two (which accounted for an additional 9% of item variance) was defined by four of the scale items and was labeled *Student Responsibility*. The third Factor was defined by two of the scale items, accounted for 7% of item variance, and yielded no interpretable factor solution. This three-factor solution, while not directly aligned with the eight-scale organization of the QTI, is not surprising. A closer look at the factor loadings of the 16 items on Factor One reveals that the eight items relating to cooperative teacher behaviors (leadership, understanding, and friendliness) load positively while the seven items relating to oppositional teacher behavior (admonishing, strict, and dissatisfied) load negatively. This sixteen-item scale holds together as a measure of student perceptions of teacher cooperative and oppositional behaviors. Because of this result, I decided to retain the three cooperative and three oppositional scales represented within Factor One. In addition, the QTI scale, student freedom, was also retained in accordance with its conceptual agreement with Factor Two, *Student Responsibility*. The eighth scale of the QTI, uncertain behavior, did not hold together as a cohesive construct and was therefore eliminated from further data analysis as a non-valid construct.

Table 4.2

Factor Loadings for Revised QTI Items

Item	Factor 1	Factor 2	Factor 3
My science teacher gets angry quickly.	-.814		
My science teacher is willing to explain things again.	.755		
My science teacher listens to us.	.828		
My science teacher is impatient	-.722		
My science teacher is a good leader	.857		
My science teacher is confident	.603		
My science teacher is patient	.827		
My science teacher helps us with our work	.789		
My science teacher is strict.	-.668		
My science teacher is friendly	.869		
My science teacher thinks that we don't know anything	-.682		
We are afraid of our science teacher	-.718		
We have to be silent in science class	-.501		
My science teacher is someone we can depend on.	.847		
My science teacher puts us down.	-.764		
My science teacher gives us a lot of free time in class	.521		
My science teacher is not sure what to do when we misbehave		.590	
My science teacher lets us misbehave in class		.754	
My science teacher lets us get away with a lot in class.		.735	
My science teacher thinks that we can't do things well		.467	
My science teacher is quick to correct us if we break a rule			.738
My science teacher knows everything that goes on in the classroom			.529
Eigenvalues	9.41	2.02	1.27
% of variance explained	42.0	9.00	7.15

Reliability of Measures

Patterns of Adaptive Learning Survey. Reliability for scales in the PALS are presented in Table 3. Reliability for each scale was estimated by computing the Cronbach's Alpha. Further, an examination of “Cronbach's Alpha if Item Deleted” suggested that all items within these scales should be retained. The reliability coefficients for the PAL scales ranged from a low, but acceptable, 0.6 to a high reliability of 0.85.

Table 4.3

Reliability (Cronbach’s Alpha) for PALS scales

PALS scale	Reliability Coefficient
Mastery Orientation	.70
Performance Orientation	.83
Efficacy for Learning Science	.73
Task Value for Learning Science	.86

Quality of Teacher Interactions. Reliability for scales in the QTI are presented in Table 4.4. Reliability for each scale was estimated by computing the Cronbach’s Alpha. Further, an examination of “Cronbach's Alpha if Item Deleted” suggested that all items within these scales should be retained except item 22 in the *Student Responsibility* scale. Cronbach’s alpha for this scale including item 22 was 0.62 and deleting item 22 resulted in a Cronbach’s alpha of 0.7. The reliability coefficients for the QTI scales ranged from a low, but acceptable, 0.64 to a high reliability of 0.86.

Table 4.4

Reliability (Cronbach's Alpha) for QTI scales

QTI scale	Reliability Coefficient
Leadership	.66
Helping/Friendly	.83
Understanding	.86
Strict	.73
Admonishing	.64
Dissatisfied	.71
Student Responsibility	.62

Descriptives

Descriptive statistics, including mean, standard deviation, variance, and range were calculated for each of the independent and dependent variables. These statistics are presented in Table 4.5.

Table 4.5

Descriptive Statistics for IV's and DV's

Variable	Mean	Standard Deviation	Variance	Range	Minimum	Maximum
Mastery Orien.	14.64	2.50	6.25	15.00	3.00	18.00
Perform. Orien.	23.38	6.79	46.11	30.00	6.00	36.00
Efficacy	13.51	2.53	6.41	13.00	5.00	18.00
Task Value	14.58	2.99	8.95	15.00	3.00	18.00
Leadership	11.92	11.92	5.56	12.00	3.00	15.00
Helping/friendly	11.84	3.03	9.16	12.00	3.00	15.00
Understanding	11.44	3.05	9.30	12.00	3.00	15.00
Student Resp.	5.28	1.76	3.09	10.00	3.00	13.00
Strict	8.40	2.86	8.16	12.00	3.00	15.00
Admonishing	9.60	2.73	7.43	11.00	4.00	15.00
Dissatisfied	5.70	2.97	8.84	12.00	3.00	15.00

Correlations

Correlations between dependent variables were calculated. These results are presented in Table 4.6. Correlations between independent variables were also calculated. These results are presented in Table 4.7

Table 4.6

Correlations between Dependent Variables

	Mastery Orientation	Performance Orientation	Efficacy for Science	Task Value for Science
Mastery Orientation	…	.289**	.498**	.665**
Performance Orientation	.289**	…	.177**	.130
Efficacy for Science	.498**	.177**	…	.453**
Task Value for Science	.665**	.130	.453**	…

** Correlation is significant at the 0.01 level
* Correlation is significant at the 0.05 level

Table 4.7

Correlations between Independent Variables

	Lead.	Help.	Und.	St. Resp.	Strict	Admon.	Dissat.
Lead.	…	.760**	.714**	.166**	-.529**	-.562**	-.556**
Help	.760**	…	.851**	.274**	-.698**	-.686**	-.694**
Und.	.714**	.851**	…	.270**	-.667**	-.723**	-.671**
St. Resp.	.166*	.274**	.270**	…	-.315**	-.325**	-.129
Admon.	-.562**	-.686**	-.723**	-.325**	.728**	…	.632**
Dissat.	-.556**	-.694**	-.671**	-.129	.581**	.632**	…

** Correlation is significant at the 0.01 level
* Correlation is significant at the 0.05 level

Multiple Regression Analysis

Multiple regression analyses were conducted with each of the four dependent variables (mastery orientation, performance orientation, efficacy for learning science and value for learning science.) For each dependent variable, a regression analysis was conducted using the seven-scale model from the QTI which was refined through the factor analysis described previously.

Mastery orientation. A multiple regression analysis was conducted to evaluate how well student perceptions of cooperative and oppositional teacher behaviors predicted mastery orientation. The predictors were the seven QTI scales measuring student perceptions of teacher behavior in the following dimensions: leadership, helping/friendly, understanding, student responsibility, admonishing, strict, and dissatisfied. The criterion variable was mastery orientation. The linear combination of student perceptions was significantly related to mastery orientation, $F(7,220) = 6.883$, $p < 0.001$. The sample multiple correlation coefficient was 0.43, indicating that approximately 18% of the variance in mastery orientation in the sample can be accounted for by the linear combination of student perception measures.

Table 4.8 presents relative strength of the individual predictors. Two of the eight perception measures (leadership, helping/friendly) were statistically significant ($p < 0.05$). None of the partial correlations between the perception measures and mastery orientation were significant.

Table 4.8

Bivariate and Partial Correlations for Mastery Orientation and QTI Scales

QTI scale	Bivariate Correlation	Partial Correlation
Leadership	0.36**	0.23
Helping/friendly	0.29 *	0.09
Understanding	0.23	-0.04
Student Responsibility	-0.13	-0.20
Strict	-0.17	-0.05
Admonishing	-0.11	-0.11
Dissatisfied	-0.23	0.06

* $p < 0.05$

** $p < 0.01$

Performance orientation. A multiple regression analysis was conducted to evaluate how well student perceptions of cooperative and oppositional teacher behaviors predicted performance orientation. The predictors were the seven QTI scales measuring student perceptions of teacher behavior in the following dimensions: leadership, helping/friendly, understanding, student responsibility, admonishing, strict, and dissatisfied. The criterion variable was performance orientation. The linear combination of student perceptions was significantly related to performance orientation, $F (7,220) = 2.205$, $p < 0.05$. The sample multiple correlation coefficient was 0.260, indicating that only approximately 7% of the variance in performance orientation in the sample can be accounted for by the linear combination of student perception measures.

Table 4.9 presents relative strength of the individual predictors. None of the bivariate or partial correlations between the perception measures and performance orientation were significant.

Table 4.9

Bivariate and Partial Correlations for Performance Orientation and QTI Scales

QTI scale	Bivariate Correlation	Partial Correlation
Leadership	0.04	0.14
Helping/friendly	-0.06	-0.06
Understanding	-0.04	0.07
Student Responsibility	-0.08	-0.01
Strict	0.13	0.04
Admonishing	0.17	0.17
Dissatisfied	0.05	-0.04

*$p < 0.05$

Efficacy for learning science. A multiple regression analysis was conducted to evaluate how well student perceptions of cooperative and oppositional teacher behaviors predicted efficacy for learning science. The predictors were the seven QTI scales measuring student perceptions of teacher behavior in the following dimensions: leadership, helping/friendly, understanding, student responsibility, admonishing, strict, and dissatisfied. The criterion variable was efficacy for learning science. The linear combination of student perceptions was significantly related to mastery orientation, $F(7,220) = 5.044$, $p < 0.001$. The sample multiple correlation coefficient was 0.377, indicating that approximately 14% of the variance in efficacy for learning science in the sample can be accounted for by the linear combination of student perception measures.

Table 4.10 presents the relative strength of the individual predictors. Four of the eight perception measures (leadership, helping/friendly, and understanding, dissatisfied) were statistically significant ($p < 0.05$). None of the partial correlations between the perception measures and efficacy for learning science was significant.

Table 4.10

Bivariate and Partial Correlations for Efficacy for Learning Science and QTI Scales

QTI scale	Bivariate Correlation	Partial Correlation
Leadership	0.31 **	0.15
Helping/friendly	0.26 *	-0.09
Understanding	0.29 *	0.11
Student Responsibility	-0.04	-0.10
Strict	-0.22	-0.07
Admonishing	-0.19	0.08
Dissatisfied	-0.30 **	-0.14

* $p < 0.05$

** $p < 0.01$

Task Value for learning science. A multiple regression analysis was conducted to evaluate how well student perceptions of cooperative and oppositional teacher behaviors predicted value for learning science. The predictors were the seven QTI scales measuring student perceptions of teacher behavior in the following dimensions: leadership, helping/friendly, understanding, student responsibility, admonishing, strict, and dissatisfied. The criterion variable was value for learning science. The linear combination of student perceptions was significantly related to mastery orientation, $F(7,220) = 4.495$, $p < 0.001$. The sample multiple correlation coefficient was 0.359, indicating that approximately 13% of the variance in value for learning science in the sample can be accounted for by the linear combination of student perception measures.

Table 4.11 presents relative strength of the individual predictors. Two of the eight perception measures (leadership, helping/friendly) were statistically significant ($p < 0.05$). None of the partial correlations between the perception measures and value for learning science was significant.

Table 4.11

Bivariate and Partial Correlations for Task Value for Learning Science and QTI Scales

QTI scale	Bivariate Correlation	Partial Correlation
Leadership	0.29 *	0.15
Helping/friendly	0.27 *	0.08
Understanding	0.20	-0.08
Student Responsibility	-0.06	-0.15

Strict	-0.23	-0.14
Admonishing	-0.14	0.09
Dissatisfied	-0.23	-0.07

* $p < 0.05$

Analysis of Variance

A series of one-way Analyses of Variance was conducted to determine whether there was a significant difference between ethnicity, gender, and teacher groups and the variables used to measure perceptions of teacher-student interactions and motivation. The ANOVAs for ethnicity revealed no significant differences. In terms of gender, two tests were significant. Female students reported significantly less efficacy for learning science than male students, $F(1, 221) = 4.262$, $p < 0.05$. In addition, females reported significantly lower perceptions of teachers' understanding behavior than male students, $F(1,221) = 4.460$, $p < 0.05$.

The tests to evaluate the relationship between teacher groups (students from Teacher One, Two, and Three) and students' perceptions of teacher-student interactions and motivation for learning science identified significant differences in the following variables: performance orientation, $F(2, 221) = 4.000$, $p < 0.05$; efficacy, $F(2,221) = 4.141$, $p < 0.05$; value, $F(2,221) = 3.908$, $p < 0.001$; leadership behavior, $F(2,221) = 41.259$, $p < 0.001$; helping behavior, $F(2,221) = 93.519$, $p < 0.001$; understanding behavior, $F(2,221) = 100.940$, $p < 0.001$; student responsibility/ freedom, $F(2,221) = 14.119$, $p < 0.001$; strict behavior, $F(2,221) = 66.361$, $p < 0.001$; admonishing behavior, $F(2,221) = 98.457$, $p < 0.001$; dissatisfied behavior, $F(2,221) = 46.124$, $p < 0.001$.

Post-hoc tests (Bonferroni) were conducted to identify the differences between Teachers One, Two, and Three for the variables determined to be significant from the ANOVAs. For the following variables, students from Teacher One reported significantly lower scores than students from Teacher Two and Three: efficacy, leadership, helping, and understanding. For the following variables, students from Teacher One reported significantly higher scores than students from Teacher Two and Three: strict and admonishing. Students from Teacher One also reported significantly higher scores for performance orientation and lower scores for value than students from Teacher Two; there was no significant difference in performance orientation and value between Teacher One and Three. There were no significant differences between students from Teacher Two and Three for any of the variables tested. Means and standard deviations for each teacher group and variable are provided in Table 4.12.

Table 4.12

Means and Standard Deviations for Teacher Groups

	Teacher 1		Teacher 2		Teacher 3	
	M	SD	M	SD	M	SD
Mastery Orientation	14.20	2.78	14.96	2.51	14.75	2.18
Performance Orientation	25.23	6.35	22.36	7.81	22.65	5.87
Efficacy	12.80	2.62	13.82	2.81	13.85	2.05
Value	13.86	3.40	15.24	2.51	14.64	2.90
Leadership	10.11	2.42	12.88	1.90	12.65	1.71

Helping	8.85	2.88	13.14	1.90	13.33	1.83
Understanding	8.42	2.86	12.33	2.06	13.33	1.61
Student Resp./ Freedom	4.44	1.39	5.85	1.96	5.53	1.59
Admonishing	12.27	2.27	8.86	2.00	7.89	1.69
Dissatisfied	8.03	3.33	4.97	2.11	4.30	1.92

Participant Selection

Following a sequential explanatory participant design, quantitative data from Phase One informed participant selection for the qualitative component, Phase Two. In order to further examine the interaction between motivation and student perceptions, quantitative data were examined to identify student participants who reported specified composites of motivation and perceptions of teacher behaviors. The decision to examine high and low extremes of these variables stemmed from a focus on understanding students' perceptions relating to higher and lower motivational profiles.

A summative score was calculated for both student motivation and student perceptions of teacher behaviors. In the quantitative analysis, student perceptions were found to be most predictive of student value for learning science and student efficacy for learning science. Consequently, the qualitative phase of the study examined these motivational constructs in further detail. Thus, a summative score for motivation was calculated using the student reported measures for value and efficacy for learning science. This summative score yielded a motivation variable which became the basis for assigning a motivational profile to each student participant.

In the quantitative analysis, cooperative teacher behaviors, as defined by the theoretical model of interpersonal behavior (Wubbels & Brekelmans, 2005), were the most highly correlated predictors of student motivation (value, efficacy, mastery orientation). Thus, a summative score was calculated for student perceptions of teacher cooperative behaviors using the reported student scores for the following scales: helpful/friendly behavior, understanding behaviors, leadership behaviors. In this interpretation, a higher reported score for teacher cooperative behaviors indicates that the student reported more favorable perceptions of teacher behaviors in the areas of leadership, helpfulness, and understanding.

Once these summative scores were calculated (motivation and teacher cooperative behaviors), they were divided into quartiles in order to identify high and low ranges for each variable. Table 4.13 summarizes the scale high and low values, score ranges, and associated statistics for each selection variable.

Table 4.13

Summary of Participant Selection Variables

Selection Variable	Lo	Hi	M	SD	Variance	Min	Max	Quartile1 Low	Q2	Q3	Q4 High
Student Motivation	8	36	28.09	4.7	22.2	8.0	36.9	8-25	25-28	28-31	31-36
Student Perceptions of Teacher Cooperative Behavior	12	60	40.52	8.4	70.8	12.0	54.0	12-35	35-43	43-47	47-54

Student scores, identified by participant numbers, were then matched to identify students fitting the following motivation/perception composites: high motivation/high perceptions of cooperative behaviors, low motivation/low perceptions of cooperative behaviors, high motivation/low perceptions of cooperative behaviors, low motivation/high perceptions of cooperative behaviors. Table 4.14 displays the frequencies of participants associated with these motivation/perception composites. Table 4.15 presents frequencies for all possible combinations of motivation/perception composites (across the quartiles for motivation/perceptions) in order to contextualize the frequencies for high and low extremity pairings. Table 4.15 demonstrates that the high motivation/ high perceptions and low motivation/ low perceptions composites contained the greatest numbers of students.

Table 4.14

Student Frequencies for Motivation/Perceptions Composites

High Motivation/ High Perceptions of Teacher Cooperative Behaviors (H-H)	Low Motivation/ Low Perceptions of Teacher Cooperative Behaviors (L-L)	High Motivation/ Low Perceptions of Teacher Cooperative Behaviors (H-L)	Low Motivation/ High Perceptions of Teacher Cooperative Behaviors (L-H)
32	24	14	8

Table 4.15

Frequencies for Quartile Pairings

	Motivation Quartile 1 (Low)	Motivation Quartile 2	Motivation Quartile 3	Motivation Quartile 4 (High)
Cooperative Perceptions Quartile 1 (Low)	24	7	11	14
Cooperative Perceptions Quartile 2	11	8	17	13

Cooperative Perceptions Quartile 3	10	10	15	13
Cooperative Perceptions Quartile 4 (High)	8	9	12	32

The decision was made to conduct paired student interviews based on district regulations. In order to control for possible peer factors during these paired interviews, students were paired according to similar motivation/perceptions composites. For example, a student with a H-H composite was paired with another student with a H-H composite, when possible. Two students were selected from each class that participated in the survey phase of the study. From the possible pool of participants meeting the criteria of one of the four possible motivation/perceptions composites, students were selected for interviews in order to be representative of the survey data and also to be representative of gender/ethnic composition of the survey population as well as the school population. In particular, a larger percentage of student interviews were conducted with students reporting H-H and L-L motivation/perceptions composites since these composites were more representative of the survey sample. In addition, a large percentage of student interviews were conducted with Caucasian students in order to align with demographics of the survey population and the school population. Table 4.16 displays the specific breakdown of interview participants by motivation/perceptions composites, gender, and ethnicity. This table also reports the percent of total students meeting each composite who were interviewed.

Table 4.16

Interview Participants and Related Demographics

	Caucasian Males	Caucasian Females	African-American Males	African-American Females	Asian Males	Asian Females	Total	% of composite (sample)
H-H	2	3	1	1	1	1	9	28%
L-L	2	2	1	1	1	1	8	33%
H-L	1	0	2	1	0	0	4	29%
L-H	0	1	0	1	1	0	3	38%
Total	5	7	4	4	2	2	24	

Qualitative Results

Following selection of participants using results from the quantitative phase of the study, a qualitative phase was conducted in order to address the following qualitative research question: How do middle school science students' perceptions of teacher-student interactions affect domain-specific motivation?

Context of Interviews

Qualitative interviews were conducted with 24 sixth grade science students. Interviews were conducted in pairs in accordance with school district regulations. As described above, students were interviewed in matched pairs in alignment with similar motivation/perception composites. Interviews were conducted with two students from each classroom that participated in the quantitative phase of the study. In total, 12 sixth grade science classrooms and three science teachers were represented by the interview participants. Interviews were conducted in an audio/visual room adjacent to the school library. Interviews averaged 20 minutes in length and were recorded using a digital voice recorder. Immediately following each interview, I transcribed the recordings.

It is important to note that I was present in these science classrooms from the beginning of the school year until April when the interviews were conducted. As part of a concurrent research project, I was in most classes several times during each semester conducting observations. This sustained presence may have allowed students to feel relatively comfortable with the researcher, as rapport had been established within the classrooms throughout the year. Interviews were conducted over the course of a week in late April. This timeline allowed for students to reflect on an entire school year, but also respected the standardized testing schedule; testing began two weeks after the completion of student interviews.

A semi-structured interview protocol was developed at the beginning of the study (primarily for IRB and approval purposes) in alignment with constructs represented in the quantitative phase. After analyzing quantitative results, this original protocol was modified in order to explore these results in more detail and to offer further insight into the interactions between students' science motivation and teacher-student interactions. Specifically, the protocol was refined to emphasize the constructs that were statistically significant in the quantitative phase: cooperative and oppositional teacher behaviors, efficacy for learning science, and value for learning science. In addition, the interview protocol addressed aspects of students' construction of these perceptions of teacher' cooperative and oppositional behaviors. In order to develop an understanding of student motivation in relation to student perceptions of teachers' classroom behaviors, it is helpful to illuminate the origins of these student perceptions. The refined semi-structured interview protocol is provided in Appendix G.

Qualitative Analysis

Data were collected and analyzed using quasi-grounded theory procedures as described in Strauss and Corbin (1998). As described above, interviews were taped using a digital voice recorder and transcribed. Interviews were uploaded to NVIVO qualitative analysis software and dimensions of each case were specified. These dimensions were drawn from the quantitative phase of the study for each participant. The dimensions that were defined for each participant on NVIVO included the following: gender, ethnicity, motivation (high or low), and perceptions of teacher cooperative behavior (high or low), motivation/perceptions composite (high/high, low/low, high/low, or low/high). The constant comparison method, or the continual comparison of data, was used to analyze interview data. Each interview was coded and compared to previous data before conducting the next interview. Open coding was used to identify initial concepts and similar concepts were grouped to create categories. Relationships between categories were identified using axial coding and properties and dimensions were elaborated. Each stage of qualitative data analysis is explained in detail in the paragraphs that follow.

Open Coding

The initial step in the qualitative analysis was open coding. This coding procedure was conducted using NVIVO as a tool for coding and naming initial concepts relating to science motivation and student perceptions of teacher behaviors. In NVIVO, these initial themes were defined as free nodes. Following the initial open coding phase of the analysis, 159 free nodes were identified. Appendix I contains a listing of all initial free nodes. These free nodes represented a wide range of dimensions related to the constructs of interest in the present study. Several screen captures from NVIVO of the initial coding process are located in Appendix H.

Following an initial period of open coding, themes were grouped to create categories. This process allowed themes to be sorted into categories with unifying concepts, thereby joining initial themes into cohesive units. Figure 4.1 details the process of grouping several initial codes to create a category and subcategories.

Figure 4.1

Grouping of Codes to Create a Category and Subcategories

Open Codes	Category	Subcategories
Challenges with additional questioning	Construction of Perceptions of Teacher Cooperative Behavior: Helpful	(1) Instructional strategies
Detailed explanations		(2) Approachable/ supportive
Giving opportunity to correct tests		(3) Available
Keeping students informed		
Monitoring and scaffolding		
Planning interactive lessons		
Perceptive		
Sense of humor		
Plans engaging activities		
Gives help without student asking		
Pushes you to think		
Simple directions		
Supportive		
Teacher as expert		
Timeline on making up work		
Makes time for students		
Encouraging		

Within these primary categories, subcategories also emerged based on predominant dimensions of each category. Figure 4.2 displays the categories and subcategories drawn from the initial 159 themes. Following the presentation of Figure 4.2, a detailed description of each category is provided with examples to illustrate each subcategory.

Figure 4.2

Qualitative Categories and Subcategories

Categories	Subcategories
Construction of Perceptions of Teacher Cooperative Behavior: Helpful	(1) Instructional strategies (2) Approachable/ supportive (3) Available
Construction of Perceptions of Teacher Cooperative Behavior: Understanding	(1) Empathetic (2) Teacher affect: Slow to anger (3) Individual attention (4) Wait time
Construction of Perceptions of Teacher Oppositional Behavior: Harsh	(1) Teacher affect: Easily angered (2) Unfair
Construction of Perceptions of Teacher Oppositional Behavior: Impatient	(1) Teacher affect: Easily angered (2) Not listening to students
Construction of Perceptions of Teacher Control	(1) Tight control: Enforcing procedures (2) Tight control: Limited patience (3) Appropriate control: Necessary to maintain the learning environment
Efficacy for Learning Science	(1) Dependent on the social structure of activity (2) Dependent on the content

	(3)	External attribution to teacher
Utility Value for Learning Science: Present Value	(1)	Understanding the world
	(2)	Understanding self
	(3)	Safety
Utility Value for Learning Science: Future Value	(1)	Science careers
	(2)	“Means to an end”
	(3)	Environmental issues
Intrinsic Value for Learning Science: High	(1)	Independence
	(2)	Interactive
	(3)	Authentic connections
Intrinsic Value for Learning Science: Low	(1)	Teacher affect: Anger
	(2)	Mindless, busy work
	(3)	Lectures/ notes
Resources Selected for Challenges	(1)	Self
	(2)	Teacher
	(3)	Peers

Categories and Subcategories

Construction of perceptions of teacher cooperative behavior: Helpful. This category emerged as students described their interpretations of their science teacher’s helpful behaviors. The following subcategories emerged as integral to students’ perceptions of teachers’ helpfulness: teacher’s instructional strategies, approachable/supportive, available, and proactive.

Students discussed instructional strategies as the primary aspect of their teacher’s helpfulness. Students viewed the following instructional strategies as helpful in their learning of science: giving detailed explanations, using challenging questions, organization, keeping students informed of due dates and assignments, planning engaging activities, monitoring students during work and using humor during instruction. One student described her teacher's organized use of notes: "Her notes are very specific and if there's something she knows is going to be on the test and it's going to be hard if you don't study it, she'll usually highlight it or remind us to highlight it." Another student described their teacher's helpful monitoring of students during classwork:

> Sometimes if you're doing classwork and you just kind of get a little sidetracked and not doing what you need to do, she'll come over and just kind of help you get back on track. And usually if you're doing that, you don't understand something and she'll help you get back on track.

Students also perceived approachability and supportiveness as integral aspects of a teacher's helpful behavior. Students described this support to be related to instruction and to general classroom dynamics. One student described his science teacher as supportive in relation to his behavior: "Like if we get in trouble, she tried to help us get out of it and not try to get in more trouble." Approachability was also deemed to be a critical aspect of teacher helpfulness: "She also tells us to ask any questions that we might have." Students described a helpful teacher as one who would not "get angry because we don't understand something."

A third subcategory of students' construction of their perceptions of teachers' helpful behavior was availability. Students described a teacher as available if they made time to help students one-on-one and were willing to meet students before or after school. One student described her experience with her science teacher making herself available:

One morning, there was this subject, and I don't really remember what, but I just did not understand it and I don't think a lot of students did. So that morning, she held this little thing and you could come and she had these groups of activities where you could do these different things and understand it.

Construction of perceptions of teacher cooperative behavior: Understanding. This category emerged as students described their interpretations of their science teacher's understanding behaviors. The following subcategories emerged as integral to students' perceptions of teachers' understanding behavior: empathetic, slow to anger, individual attention and wait time.

Students described teacher empathy as a key aspect in their perceptions of an understanding teacher. Students valued a teacher who "understands that we have five other classes and the work that we have to do." One student also described her teacher as understanding "because sometimes we have a lot of stress put on us with having to worry about projects and classwork and homework." Students perceived an understanding teacher and one who empathizes with the many challenges and stresses that students are facing and recognizes these experiences as legitimate and relevant.

A central aspect of students' perceptions of an understanding teacher centered on teacher affect: slowness to anger. This was especially true in relation to a teacher's propensity to display patience when students do not understand the content. One student stated, "She doesn't get mad at you for not understanding something." In addition, students viewed teachers as understanding if they were patient with student behavior: "Everyone was being extremely bad, like off the walls and everything…and most teachers would just yell and start threatening with detention. But she just asked us to be quiet nicely and told everyone to calm down."

Students also described understanding teachers as giving individual attention to students. This subcategory centered on students' need to feel that the teacher viewed them as an individual with individual needs; an understanding teacher will attempt to meet the needs of each student. One student described the importance of individual attention from her teacher: "There was once in the global wind chapter and I couldn't understand some of the winds And it was like one day before the test. And I had so many questions. But she patiently sat with me and went over each one of them." Other students also echoed this theme, describing their science teacher as understanding because of the one-on-one time that she spent with them apart from whole class instruction.

Students also perceived teachers as understanding when they provided wait time, either during whole class discussions or during group or individual work. Students viewed wait time as a sign that their teacher was cognizant of their needs to process material without quickly moving on to the next question. One student described his science teacher as understanding because of her use of wait time during class discussions:

> Like when you don't know, and you take like ten seconds she won't pick on someone else, she'll stick with you. I mean, she's stayed with people for like two and three minutes before. I mean she sort of eases them closer to the answer and when they finally get the answer, then she goes and recaps like, 'How did you get that answer?'

Students also described their science teacher's understanding of their need for additional time to complete group and individual assignments. Students valued their teachers' understanding that the students' timetable was often different from the timetable the teachers has anticipated before the lesson.

Construction of perceptions of teacher oppositional behavior: Harsh. This category emerged as students described their interpretations of their science teacher's harsh behaviors. The following subcategories emerged as integral to students' perceptions of teachers' harsh behavior: easily angered and unfair.

The most prevalent subcategory to students' perceptions of a teacher as harsh was teacher affect, the teacher's ability to be easily angered. Students discussed this theme more than any other subcategories within any of the oppositional teacher behaviors; this was a subcategory with resonated with many students within the present study. The most common response given by students was something to the effect of, "She gets mad easily" when describing a harsh teacher. One student stated that a harsh teacher "has a temper problem" and another described a teacher who "has the ability to get mad fast." Students' perceptions of a harsh teacher as one who is easily angered affected the way in which students were willing to interact with their teacher during class. One student commented, "Sometimes I get scared to ask her questions because she yells at you when you ask her a question, so I'm like, 'Should I go ask her this?' So I'll just look in my notes if we're allowed to."

Students also described a harsh teacher as unfair. Students described how a harsh teacher will often get angry at the entire class for something that only a few students have done. One student described this scenario from her science class: "Sometimes she has a little temper problem, like if the class before us makes her mad." Students expressed their frustration that the teacher was being unfair to express anger for something a previous class had done. Other students commented that the class would frequently receive long lectures if just one or two students were misbehaving: "We get lectured a lot of the time so a lot of our time goes out because she lectures a lot." Students viewed this as unfair because it took away from time that they could be doing more hand-on and engaging activities in class.

Construction of perceptions of teacher oppositional behavior: Impatient. This category emerged as students described their interpretations of their science teacher's impatient behaviors. The following subcategories emerged as integral to students' perceptions of teachers' impatient behavior: easily angered when students don't understand, not listening to students, and excessive "busy" work.

As with students' perceptions of teachers' harsh behavior, students mentioned teacher affect, the teacher's propensity to be easily angered as a central aspect of their perceptions of impatient behavior. A key difference, however, was the focus of this subcategory. In relation to impatient teacher behaviors, students described a teacher who is easily angered when students don't understand science content. This differs from the more general subcategory, "Easily angered," for students' perceptions of teachers' harsh behaviors. One student describes how her teacher reacts with students who don't understand material: "I don't like to ask her a question. Like I told my mom, 'My teacher yells at us when we ask questions.'" In contrast to students' view of a patient teacher as a teacher who is slow to anger when students need extra help, students perceived an impatient teacher as angry and unwilling to take the time to explain material that may be confusing to students.

Students also perceived an impatient teacher as one who is unwilling to listen to students. While students described a patient teacher as one who is empathetic, students viewed impatient teachers as unwilling to see their side of issues and unwilling to listen to students' viewpoints. One student described her teacher as unwilling to listen to details about her life: "We have a lot, like most of us do, a lot of afterschool activities and we don't have any time in our schedule to do a lot of homework and if we don't do it, then the next day she's like, 'Why didn't you do your homework?'" These students were also clear that they understood the importance of homework and assignments; they expressed a desire for their teachers to listen to them and try to understand when other aspects of their lives were overwhelming. This sentiment also related to the amount of work that they were expected to complete. Students tended to describe their teachers as impatient if they assigned "excessive amounts of homework" while not taking students' other courses into account. The majority of students wanted their teachers to listen to them instead of labeling student concerns as "just an excuse."

Construction of perceptions of teacher control. This category emerged as students described their interpretations of their science teacher's control in the classroom. The following subcategories emerged as integral to students' perceptions of teachers' control: tight control/ enforcing procedures, tight control/limited patience and appropriate control/necessary to maintain the learning environment.

Students perceived tight teacher control as enforcing classroom procedures. Students perceived the teacher as having tight control of the classroom by making sure that students are not breaking pre-established rules, such as talking out of turn, getting out of their seats, sitting in their chairs, or being disrespectful. Students described how their teacher would enforce procedures, even when students were not engaged in disruptive behaviors. One student commented on her teacher's established procedure for sharpening pencils: "Even if we get up to sharpen our pencil, we get yelled at. I mean, we aren't doing anything, so why do we get yelled at? Just like the simplest stuff like asking someone for paper or a pen." Students described a controlling teacher as follows: "Every time you do something, they have to pick you out for no reason." One student described his teacher as controlling because she exerts control over every detail, even how students should sit in their seat: "If you aren't sitting right…sometimes she might give you a referral."

A second subcategory of students' perceptions of teacher control is tight control: limited patience. As noted in the discussion of the category *Construction of perceptions of teacher oppositional behavior: Impatient*, students described a teacher with tight control as one who does not listen to students to empathize with their needs and special circumstance. It is not surprising that there should be an overlapping of categories and subcategories in the analysis of students' perceptions of teacher oppositional behaviors and teacher control; dimensions of these behaviors are tightly connected and share many similarities. A complete description of students' perceptions of teacher impatience is provided in the analysis of the category *Construction of perceptions of teacher oppositional behavior: Impatient.*

Students also described teacher control as appropriate control: necessary to maintain the learning environment. While students tended to view the previous two subcategories in a negative light, students reported that some teacher control is a favorable characteristic in a teacher when she needs to deal with disturbances to the classroom environment. One student summed up this view in his candid interpretation of her teacher:

> Any teacher should be strict. A total push-over isn't good and lets the students spend all the class in the bathroom texting. But usually she doesn't have to be strict because 88.8% of the time we're behaved but we're in 6th grade, so whenever the teacher turns around, it's time to talk. It doesn't bother her that much either. She just says, 'Mouths shut.' And then we're all good and progress.

Another student clarified her view of teacher control as a positive, as long as it is fair and directed at the students who have caused problems in the class: "Like if she knows she needs to be strict, she'll get strict. But she'll get strict on the problems and not other people who aren't the problem." This student perception of equity in teacher control differentiates these views from some of the more negative views of teachers as unfair or easily angered; students were able to discriminate between these dimensions of teacher control and see that discipline can serve to maintain a peaceful learning environment.

Efficacy for learning science. This category emerged as students described their efficacy for learning science. The following subcategories emerged as integral to students' perceptions of their science efficacy: dependent on the activity, dependent on the content, and attributions to teacher-factors.

Students frequently described their efficacy for learning science as contingent on the social structure of the activity. Students generally felt more confident in situations where there was scaffolding, either in the form of teacher assistance, peer assistance, or the use of notes or textbooks. One student stated: "I feel confident if I get to use my notes because I can find information better or if I study! But if it's just like a pop quiz or something and I haven't studied, then it's a lot harder." One student also reflected on her efficacy for learning science in relation to the mode of instruction: "Science is kind of boring for me. It's not really my strongest subject. And I'm not saying that school has to be fun, but I would pay more attention if it was hands-on a lot. I mean, it's all right, but it's not my strongest subject." Students also felt more confident when completing activities in groups or with a partner as opposed to individual tasks completed alone. During these group activities, students felt more confident due to the fact that they could approach peers for assistance and pool their efforts to approach a difficult task.

Students' efficacy for learning science was also contingent on the content. Students frequently discussed the transition to middle school science content as a source of increased difficulty and lower confidence for learning science. One student described this transition: “Some of the harder things are like, there’s a lot more information this year, like under a topic and it gets a lot more involved than last year.” Students also reported higher efficacy for learning concepts in life science than concepts in physical science. This tended to hinge on students’ ability to relate to examples from their daily lives to support their learning of new concepts. Students felt that they had more prior knowledge about concepts relating to plants and animals, therefore resulting in higher efficacy for learning new material in these areas. Students reported less familiarity with concepts such as motion and earth science, and also felt less confident in their ability to learn new concepts in these areas of science.

The final subcategory to emerge for student efficacy for learning science was students’ external attributions to teacher factors for their science efficacy. Students commented on the ways in which their teacher contributed to their confidence for learning new material in science: “My teacher gives us a lot of notes and things to study by and she won’t stop until she knows we understand it. She won’t just kind of say, ‘Well, that’s it for today.’” Many students acknowledged their teacher’s role in raising their confidence in their ability to learn challenging concepts, especially new, more complex material at the middle school level. As one student commented, “I guess it’s not easier (science material in middle school), but I think my teacher is the best teacher we have for teaching it.” Another student noted that his teacher, “defines things a lot better for us; she makes it easier.”

Utility value for learning science: Present value. This category emerged as students described their present value for learning science. Utility value refers to the student’s perception of how useful a given task or domain is in his/her life, in this case, science (Eccles & Wigfield, 1992). The following subcategories emerged as integral to students' perceptions of the present utility value of science: understanding the world, understanding self, and safety.

Students viewed science as important in their present, daily lives in terms of understanding the world around them. This understanding encompassed many areas, including recognizing animals and plants, being informed about new technologies, and making sense of environmental issues. One student noted, "I think it's just important to the whole world because it's changing so fast. It's important that we know this stuff." Students also discussed the relevance of science to issues affecting the environment, such as recycling and climate change. Other students noted more practical applications of science to their daily lives: "We just learned about plants so if you want to grow a plant, you know how to take care of it."

Students also viewed science as important in their daily lives in terms of understanding themselves. By learning about their bodies and how to care for their bodies, students recognized science, especially health science, as an important aspect of their lives. Specifically, students mentioned the importance of "brushing your teeth and learning how to have good hygiene" as an application of science to their present lives. In addition, students reflected on gaining an understanding of how their actions affect the world around them; learning about their personal uses of energy and resources helped them to see their personal effect on the environment.

Students also valued science in their daily lives because of lessons learned about safety. One student discussed the way science may keep him safe while taking a hike: "Because of fungus and things…you don't want to be out there and see something and not know what it is…but if you know your science, you'll be like, 'Don't touch that!'" Students also discussed weather safety as a valuable lesson in science. Learning how to react to severe weather situations was seen as important to personal safety; knowledge about interpreting weather forecasts and conditions could give students advanced warning of severe weather in their area. One student illustrated this point: “So we need to know about the weather and that can help you, like in a life or death situation. Maybe, like in a tornado. Or maybe in a hurricane, you think that the hurricane has passed and you’re just in the center and the worst is yet to come.” The idea of weather safety was a frequently-mentioned topic among the students.

Utility value for learning science: Future value. This category emerged as students described their future utility value for learning science. The following subcategories emerged as integral to students’ perceptions of the utility value of science for their future: science careers, “means to an end,” and environmental issues.

Students predominantly viewed science as valuable in the future for individuals planning to pursue careers in science. One student stated: “Well, I’m not going to say that science is the most important subject. It might be if depending on what job you want to have.” Students perceived science as valuable in the future for careers such doctors or meteorologists. Another student discussed her similar views on the value of science for the future: “I think it’s pretty important. Like I think it’s pretty useful. Like if you wanted to have a certain career when you get older, some of the stuff you learn in science can help you.” This subcategory accounted for the majority of students’ responses related to the future value of science. An interesting note, however, relates to students’ personal identification with this theme. While most reported that science is valuable for future science careers, many students did not see the relevance of science for their own personal futures. One student stated: “Yeah, science is important for the future if you want to be a doctor or a veterinarian. I want to be a doctor when I grow up, but I don’t think I’ll use what I learn now in middle school science. I’ll learn all the important stuff later, like in college." Several other students also displayed a disconnect between their own career goals and the future usefulness of the science they were learning in their middle school years.

Students also discussed the future value of science as a "means to an end." This subcategory was evident in both students who planned to pursue careers in science and those who had other future goals. Mastering the actual content of science was seen as secondary to securing the grades necessary to take the next step in their career aspirations. For example, one student stated: "To be a meteorologist, I need to get good grades in both Science and Math." Other students with goals of playing college sports cited the necessity of learning science for getting good grades so that they would be eligible to play sports: "Because if you want to play a sport, then you have to go and finish college. I think that science and math are the most important subjects in school and you might have to pass those two subjects to play the kind of sports you like." This subcategory is discussed further in Chapter Five in relation to dimensions of students' value for science and how this affects motivation and goal orientations.

A third subcategory emerged related to students' perception of the future value of science in regard to environmental issues. Students reported that learning about the environment would be useful for the future so that they could make a positive impact on the world around them. One student reflected on his future role in environmental awareness: "I think I'll use it (science). Like people are littering a lot and they need to be more cautious about what they do, like cutting down trees and killing the environment and animals." Learning about recycling was also a common theme as students talked about the value of science for their future.

Intrinsic value for science: Positive. This category emerged as students described their intrinsic value for science. Intrinsic value refers to a student's enjoyment of the task or domain, in this case, science (Eccles & Wigfield, 1992). This category emerged from students' statements related to their feelings about science; these statements generally began with either, “I like science because…” or “I don’t like science because…” The subcategories presented are the principal themes that students cited as influencing their intrinsic value for science. The following subcategories emerged as integral to a positive intrinsic value for science: interactive activities, independence, real-world connections.

The most prevalent subcategory influencing students’ positive intrinsic value for science was their affinity for interactive activities in science class. Students frequently referred to these activities as “hands-on;” however, this term is often misconstrued in research and practitioner literature. By and large, students described activities that required them to engage their minds in learning, not just their hands. Therefore, I made the decision to name this subcategory “interactive activities” in order to best represent the construct. Students described a positive affect for science when given the opportunity to participate in interactive labs and group activities. One student described an engaging activity: “She gives us projects that we can learn by ourselves and doesn’t always give us the answers. When we dissected the lily, she didn’t really tell us how to do it. We just started off saying, ‘What’s this? What’s that?’ And sometimes we ended up cutting the wrong thing, but then she (teacher) would tell us when we were wrong.” Students also reflected on how these interactive activities contribute to their learning of science concepts: “Hands-on is how I feel like I learn; like I don’t feel like I learn from just taking notes.” Some students also described a more positive affect for science in middle school than in elementary grades and attributed this shift to more engaging activities: “I like it. It’s more interactive this year. Last year it was more like just reading from the book. This year we get to do a lot more hands-on things, not just reading the book. Kind of experimenting.” In an interesting statistic, students mentioned their enjoyment of interactive activities 41 times during the interviews; this is double the frequency of any other subcategory represented in this qualitative analysis.

Independence in the classroom was another concept contributing to students' positive intrinsic value for science. Students discussed their independence in relation to teacher factors, such as providing students with more space and freedom in the classroom. One student described how her teacher "gives us more space to do what we feel like we want to do during assignments instead of being over our shoulder telling us what to do." Students also reported a positive affect for science when they were given choices during activities; these choices ranged from choice of topic to choice of partner for the activity. This subcategory is discussed in greater detail in Chapter Five in relation to self-determination theory.

Authentic connections also positively influenced students' intrinsic value for science. When connections were made between science content and real-world applications, students were able to see the relevance of these concepts in their own lives. This subcategory directly relates to the construction of students' value for science in their daily lives; students cannot perceive the value of science in their lives if they miss the real-world connections. Several students mentioned their study of weather and its relevance to real-world situations: "My favorite was when we got to look at the weather and stuff on the computer and then recorded it with the clouds we saw outside." Students also saw real-world connections during field trips connected to their science class, such as a trip to a science center to see how concepts of electricity and current are applied in a real-world setting. Students had a positive affect for science when they had the opportunity to experiment with real-life science scenarios, such as learning how a car battery operates: "We charged a battery one time. We had to charge it and see how far we could get it to move across the table. We had to build the battery and connect the wires to a battery." These real-world applications of sometimes abstract concepts in science help students to develop a positive affect towards science and also to construct a sense of value for science.

Intrinsic value for science: Negative. This category also emerged as students described their intrinsic value for science. The following subcategories emerged as integral to a negative intrinsic value for science: teacher affect: anger, mindless, busy work, excessive lectures and notes.

The principal subcategory contributing to students' negative intrinsic value for science was a perception of their science teacher as angry. This subcategory of teacher affect relating to teacher anger emerged in three categories: *negative affect towards science, students' construction of oppositional behaviors: harsh,* and *students' construction of oppositional behaviors: impatient*. This concept of a teacher as angry is influential in several key areas related to students' perceptions of science and of their science teachers. A complete description of this subcategory can be found in *students' construction of oppositional teacher behaviors: harsh* and *impatient*.

Students also reported a negative intrinsic value for science when they perceived their assignments as "mindless, busy work." Students usually described this type of work as an assignment that required them to complete repetitive tasks to fill time. These activities were frequently described as "just sitting there doing work." Students also had a negative affect for science when they were given multiple assignments from workbooks: "Sometimes she just gives us a whole bunch of worksheets to do." This busy work was also described in relation to the teacher's involvement during these activities. Students usually described the teacher "working at her desk" without engagement with students while they completed their assignments.

Taking excessive notes and listening to lectures were also cited as contributing to students' negative intrinsic value for science. One student described her reasons for having negative sentiments towards science: "She just gives us notes after notes after notes and goes on with just talking and no activities." Another student commented on her aversion for certain forms of note taking: "I like it when she gives us a copy of the notes and we have to fill in the blanks. But when she makes us write all the stuff, I just don't like that." Students also reflected on note taking and lectures in relation to their learning of science concepts: "Like I don't feel like I learn from just taking notes. Sometimes we'll just have sentences with blanks in them to fill in the word that's missing. So we're not really learning anything."

Resources Selected for Challenges. This category emerged as students described their strategies for approaching complex or difficult tasks in science. The following subcategories emerged as student resources selected for challenges in science: self, teacher, and peer. Many students reported using more than one of these strategies or a combination of these strategies when confronting a difficult science task.

Students viewed the teacher as a resource when confronting a challenging task in science. One student commented: "My teacher lets us ask a lot of questions during assignments, so if we have a question about anything, we just go and ask her." Other students noted that they frequently "ask the teacher to explain something." Many students were not comfortable asking their teacher for help if they perceived her as easily angered. This concept is discussed during the axial coding and the discussion in Chapter Five.

Students also viewed their peers as a resource when confronting difficult science tasks. Many activities were completed in groups, so students frequently had the opportunity to work together to solve problems. Students also identified key peers who are mastery models and sought help from those students: “I mean if it’s something hard for me…we have partners and table groups to work with and there’s usually that smart kid in the group that knows it.” Other students would “look around at how other children are doing stuff,” in essence modeling the strategies of other students.

Students also reported using themselves as a resource when approaching a difficult task in science. These students relied on their skills for problem-solving such as re-reading the question and making sure they understood the task. Students described how they would “re-read the question and the instructions” or “think back to what you did and the lesson you had” when working on a difficult task. Students also relied on their notes or seek information from a textbook. One student stated: “If I do get something a bit tougher, I will pull out some notes or mostly the book. I rely on the books more than my notes because I might have missed a slide.” These students reported using problem-solving skills and independent strategies that decrease their reliance on peers and their teacher when difficult tasks arise.

Axial Coding

In the next phase of data analysis, relationships between the categories and subcategories were identified and properties and dimensions of the categories were elaborated in relation to dimensions of each case. In line with the primary qualitative research question, this phase of analysis focused on identifying dimensions of the interaction between student science motivation and student perceptions of teacher behaviors. These results are presented in relation to each category represented in the initial qualitative analysis and related distinctions between motivation/perceptions composites. While most analysis was done by hand, running queries on NVIVO also provided clarity regarding relationships between categories and subcategories. Appendix J provides a step-by-step look at one query involving student motivation and perceptions and intrinsic value for science. Figure 4.3 highlights major findings from the axial coding phase by presenting a comparison of motivation/perceptions composites. A detailed narrative of these findings follows Figure 4.3.

Figure 4.3
Comparison of Motivation/Perceptions Composites

	Coop Behaviors	Opp Behaviors	Efficacy	Value	Strategy
High M/ High P	Made the most references to coop behaviors in most detail Teacher control as positive	Made the fewest references to opp behaviors (in relation to class)	Highest efficacy for learning science and for difficult tasks	Highest intrinsic and utility value (present and future)	Self
Low M/ Low P	Made the fewest references to coop behaviors	Made the most references to opp behaviors in most detail (in relation to self) Teacher control as negative	Lowest efficacy for learning science and for difficult tasks	Lowest intrinsic (teacher factors) and utility value (present and future)	Teacher
High M/ Low P	More references to coop than opp behaviors Most balanced references	Fewer references to opp than L-L	Low efficacy for science but higher efficacy for difficult tasks	High intrinsic and utility value for learning science	Peers Self
Low M/ High P	Only made references to coop behaviors	No references to opp behaviors	Few comments on efficacy for science More confident for difficult tasks (contingent on teacher)	Low intrinsic value for science (content) Neutral about utility value for science	Teacher

High motivation/high perceptions. An analysis of motivation/perception composites revealed that students with a high motivation-high perceptions profile made the most references to teacher cooperative behaviors. In addition, high-high students described these cooperative behaviors in the most detail and used specific classroom examples to describe their experiences.

These students provided specific examples of their teachers using helpful instructional strategies and viewed their teachers as approachable and available both in and out of the classroom. The high-high group also described fewer teacher oppositional behaviors and tended to view teacher control as a positive teacher characteristic. These students defined teacher control as integral to maintaining order when necessary and not allowing the class get out of hand.

The high/high group described the highest levels of efficacy for learning science. Though these students were cognizant of the more demanding nature of middle school science, they maintained a high level of efficacy for the subject. Many of these students attributed their confidence for learning science to teacher factors. When faced with a difficult task, students with a high-high composite reported a wide range of strategies for approaching the task. These students reported the highest level of efficacy for approaching difficult tasks and noted specific strategies for dealing successfully with these tasks. They would most often use “self” as a resource by relying on problem-solving strategies, referring back to primary sources, and breaking tasks into manageable units. Students also reported using peers as a resource and would seek teacher help after all other resources had been exhausted.

Students in the high-high composite group also reported the most utility value for science, both present and future value. These students tended to view science as relevant both to their daily lives and to their future. In terms of daily life, these students valued science as a means for understanding the world around them. In terms of future value, these students saw science as relevant to career goals. In addition, they also reported that science would be valuable in understanding environmental issues and acting as responsible citizens.

In relation to intrinsic value for science, students with a high/high composite reported the most positive intrinsic value for science. Words these students used to describe science in general included the following: “exciting, fun, important, interesting, inquisitive, fascinating.” This group reported negative affect primarily in relation to methods of instructional delivery. Sitting through lectures and taking notes were viewed as “boring and dull.”

Students in the high-high group were most likely to report teacher and classroom characteristics to describe their positive affect towards science. They cited a relaxed classroom atmosphere, teacher energy and engagement, and teacher emphasis on real-life applications as key contributions to their positive sentiments towards science.

Low motivation/low perceptions. Students with low-low motivation/perception composites cited more examples of oppositional teacher behaviors in relation to their science teachers. These students also described oppositional behaviors the greatest detail. While high-high students mentioned oppositional teacher behaviors in relation to the class, low-low students reflected on oppositional teacher behaviors in reference to their own personal experiences. These students also viewed teacher control in a negative light, frequently discussing teachers’ adherence to class procedures and singling students out for misbehavior.

In terms of motivation, low-low students reported the lowest self-efficacy for their ability to learn science. These students were also cognizant of an increased difficulty in content during their transition to middle school science and expressed low efficacy for meeting the more demanding subject matter. Student with a low-low composite were more likely to attribute their lack of confidence to this increased difficulty in content and a shift in instructional styles. These students perceived a lack of hands-on activities and less use of technology in the classroom as contributing factors to their difficulties with middle school science. Low-low students specifically noted low efficacy for approaching complex tasks. Their preferred strategy was to seek help directly from the teacher. Because of their reliance on teacher assistance, these students seemed to expect more one-on-one attention from their teacher, which they did not perceive as being provided in their classrooms. This is in contrast to the more independent, self-reliant nature of students in the high-high composite. It is possible that student expectations of their teachers, tied closely with efficacy, could influence their subsequent perceptions of teacher behavior. This idea is discussed in further detail during the discussion in Chapter Five.

Students with a low-low motivation/perceptions composite also reported the lowest present utility value for science, often citing science knowledge as important solely for the purpose of completing classwork and homework assignments. Low-low students also reported the lowest utility value of science for the future. Many students matching this motivation/perceptions profile viewed science as a "means to an end" of achieving other goals, such as playing sports in college.

In terms of intrinsic value for science, low-low students reported the most negative intrinsic value for science. These students used words such as "hard," "boring," and "difficult" to describe their sentiments about science. Low-low students also expressed a general apathy towards the content, often seeing it as disconnected from their lives. This sentiment relates to the low present value many low-low students reported, indicating a disconnect between science content and real-world applications. These students also talked repeatedly about excessive work and teacher characteristics as contributing to their negative affect toward science. In this analysis, teacher anger emerged as a distinct theme in low-low students' negative affect toward science. In contrast to the high-high composite group, who attributed their generally positive affect towards science to teacher factors, low-low students attributed their negative sentiment toward science primarily to teacher factors. This finding suggests that teacher factors were influential in students' development of positive or negative affect toward science.

High motivation/low perceptions. The high-low motivation/perceptions composite represented students who reported a high motivation for science, but who reported low perceptions of their teachers' cooperative behaviors. In other words, these students' motivation could be viewed as "resilient" despite the fact that lower teacher interactions were reported. This group represents an important aspect of the study, to study all possible motivation/perception components, not to limit the qualitative phase to examples that confirm the hypothesis that motivation and student perceptions of teacher-student interactions are related. This high-low composite group, and the subsequent low-high group, represents an attempt to remove bias from the study and examine non-examples of the motivation/perceptions hypothesis.

In general, students from the high-low composite reported more examples of teacher cooperative behaviors than oppositional behaviors. However, these examples were more balanced than those given by students in the high-high or low-low groups. These students discussed aspects of their teachers' helping behavior in terms of instructional strategies and teacher personal characteristics. Students reported roughly an equal amount of teacher oppositional behavior, with most comments related to teacher impatience or strict practices in enforcing classroom procedures. In terms of the quantitative data, these students' positive reports of teacher cooperative behaviors are not in complete alignment with their reports from the survey data. This could be due to peer factors or tendencies towards performance orientation; these students may have been hesitant to discuss negative teacher qualities without balancing this with a discussion of positive qualities. This is distinctive from the low-low composite, in which students relegated their discussion primarily to negative teacher behaviors.

Students in the high-low composite reported a general lack of confidence in science. This finding was also contradictory with the quantitative data, in which these students reported high efficacy for learning science. Since this group was smaller than the high-high or low-low composite groups, it is possible that a limited array of student voices in the H-L range were represented in this qualitative portion of the study. Perhaps these students reported higher efficacy for science during the survey phase and then had more of an opportunity to reflect in-depth during the interview portion. Since this inconsistency was not evident in any of the other motivation/perception composites, individual student factors may have been at play in this discrepancy between survey results and interview data for the high-low composite group. However, students in the high-low composite group reported a higher efficacy for approaching difficult tasks than their efficacy for learning science in general. They generally reported seeking help from peers or relying on self-reflection to determine the best course of action for a difficult task. This discrepancy between high-low students' efficacy for learning science and their efficacy for approaching difficult tasks is intriguing. Perhaps when science is broken down into individual aspects, such as specific tasks, the subject does not appear as daunting as considering science as a whole. It is also relevant to note that students in the high-low category perceived their transition to middle school science in a positive light. They tended to view middle school science as more interesting and more demanding than elementary level science. Perhaps this juxtaposition between interest and cognitive demand contributes to the discrepancy between survey and interview reports. These students could still be adjusting to this interesting, yet demanding transition, affecting their own reflection on their experiences.

Students in the high-low group reported high utility value for science, but to a lesser degree than the high-high composite group. These high-low students reported that science had both present and future utility value. Most students attributed the present value of science to understanding phenomena in the world, such as weather and plants. In terms of future value, high-low students reported almost unanimously that science is important for students who will be pursuing future careers in science. While their future value was high, students in the high-low group viewed science as valuable primarily for students pursuing science as a career. This finding is in contrast to the high-high group who reported a more general future value for science, even for students who do not pursue science careers.

Students with a high-low composite generally maintained a positive intrinsic value for science. They found the content generally interesting and described hands-on activities as “fun.” In terms of negative aspects of science, high-low students seemed to be most sensitive to instructional strategies, noting a strong aversion to excessive note-taking and lectures. These students reported a desire for more independence in science, as well as more choices.

Low motivation/high perceptions. Students in the low-high composite represent those participants who reported a low motivation for science, yet high perceptions of teacher-student interactions. It is interesting to note that this group reported no examples of teacher oppositional behaviors; all reports centered on elements of teachers’ cooperative behaviors. Students in this low-high composite group focused primarily on teacher patience and their personal experiences with their science teacher’s willingness to give one-on-one assistance and to give additional wait time in class. These students viewed their teachers’ patience as a valuable quality and helpful in their learning of science content.

Students in the low-high had very little to say in terms of their efficacy for learning science. When questions were posed such as, “Do you feel confident in science?” students seemed to have difficulty reflecting on their efficacy for learning science. Typical responses were neutral, such as “I don’t know.” In relation to approaching difficult tasks, students were more confident, though still did not elaborate. However, students did report using the teacher as a primary resource when they encountered difficult situations in science. In contrast to the low-low group, who also reported this teacher-centered strategy, students in the high-low group perceived their teacher as helpful and willing to give assistance when necessary. The efficacy for the low-high students was contingent upon their teachers' availability when a challenging task was presented. Perhaps this factor accounts for students reporting more confidence for difficult tasks, when the teacher is often available to offer help, than for science in general, when the teacher may not be able to offer assistance on tests or exams.

Students in the low-high group reported a low utility value for science in both the present and the future. Students were generally "unsure" about the relevance of science to their daily lives or reported no value at all past the classroom. In relation to the future, low-high students perceived science as somewhat important for students who were planning to enter careers in science. However, since the students interviewed did not report interest in pursuing a career in science, they viewed science as having little future value for their lives.

In terms of intrinsic value for science, students with a low-high composite generally reported negative intrinsic value for science. Students described the subject as "hard," "weird," and "boring." In particular, students disliked the more complex content of middle school science as well as many of the written tasks, such as writing up lab reports. While hands-on experiments were among their favorite aspects of science, students in the low-high composite had a difficult time discerning the relevance of these activities; in general, these students exhibited low efficacy and value for science, but had a favorable outlook towards their science teacher. In reference to the current study, these students highlight the importance of considering a variety of variables to explain student motivation in science. While the current study is focused on examining the interaction between student motivation and student perceptions of teacher-student interactions, this low-high composite group provides evidence that positive interactions are but one variable in the development of students' subject-specific motivation.

Summary

This chapter has detailed the quantitative analysis, participant selection, and qualitative analysis of data collected in order to investigate the following key research questions:

- (Overarching) What relationship exists between middle school science students' perceptions of teacher-student interactions and their motivation for learning science?
- (Quantitative phase) To what degree are students' perceptions of teacher-student interactions predictive of their motivation for learning science?
- (Qualitative phase) How do middle school science students 'perceptions of teacher-student interactions affect their task value, self-efficacy, and goal orientation for learning science?

During the first quantitative phase of the study, multiple regression analyses revealed that students' perceptions of teacher cooperative behaviors were significant predictors of students' efficacy for learning science, value for learning science, and mastery orientation. In order to further explore these interactions between students' perceptions of teacher interpersonal behavior and motivational constructs, a participant selection model focused on identification of students who met the criteria for one of the following motivation/perceptions composites: high motivation/high perceptions (of teacher cooperative behaviors), low motivation/low perceptions, high motivation/low perceptions, and low motivation/high perceptions.

During the qualitative phase of the study, the following categories emerged as integral to students' perceptions of teacher interpersonal behavior and motivational constructs: (1) *construction of perceptions of teacher cooperative behaviors: helpful*, (2) *construction of* *perceptions of teacher cooperative behaviors: understanding,* (3) *construction of perceptions of teacher oppositional behaviors: harsh,* (4) *construction of perceptions of teacher oppositional behaviors: impatient,*(5) *construction of perceptions of teacher control,* (6) *efficacy for learning science,* (7) *utility value for learning science: present,* (8) *utility value for learning science: future,* (9) *intrinsic value for science: positive,* (10) *intrinsic value for science: negative,* and (11) *resources selected for challenges*. Further analysis examined these categories in light of the motivation/perceptions composites in order to illuminate interactions between students' perceptions of teacher's cooperative and oppositional behaviors and their efficacy and value for learning science. Concepts of students' construction of perceptions of teachers' interpersonal behavior, as well as students' affect for science learning were also detailed.

Chapter Five provides a further discussion of these quantitative and qualitative results and offers implications for middle grade science education, science teacher education and professional development. Future research directions are also discussed

Chapter Five: Discussion

This study was grounded by the following overarching research question: What relationship exists between middle school science students' perceptions of teacher-student interactions and students' science motivation? This sequential explanatory mixed methods study posed two phase-specific research questions in order to investigate this overarching research question through separate quantitative and qualitative phases. Data were mixed between the quantitative and qualitative phases of the study using a participant selection model and mixed again at the interpretation level. The following sections present each phase-specific question and a discussion of the relevant findings for each phase of the study. These sections are then followed by a discussion of the overarching research question, informed by the phase-specific results and interpretation.

Discussion of Quantitative Findings

The quantitative phase of this mixed-methods study was grounded by the following research question: To what degree are students' perceptions of teacher-student interactions predictive of students' science motivation? In order to explore this question, it was necessary to measure students' science motivation as well as their perceptions of teacher-student interactions. Two measures were used in this quantitative phase: (1) Student Science Motivation: A revised version of the Patterns of Adaptive Learning Survey (PALS) and a Task Value Scale (Appendix C) measuring students' mastery orientation, performance orientations, efficacy for learning science, and value for learning science. (2) Students' Perceptions of Teacher-Student Interactions: A revised version of the Quality of Teacher Interactions Survey (QTI) (Appendix D). Surveys were completed by 224 sixth-grade science students representing 12 classes and three teachers.

Multiple regression analyses were used to examine whether perceptions of teacher-student interactions were predictive of student motivation in science. Findings revealed that students' perceptions of teacher interpersonal behavior (cooperative and oppositional) were predictive of students' efficacy for learning science, value for learning science, mastery orientation, and performance orientation. The overall model of students' perceptions of teachers' cooperative and oppositional behaviors was a significant predictor of their motivation for science.

Zero-order correlations between motivation constructs and students' perceptions of teacher interpersonal behavior were also examined. Significant positive correlations were identified between students' mastery orientation and their perceptions of their teachers' leadership and friendly/helping behaviors. Similarly, significant positive correlations were also identified between students' value for learning science and their teachers' leadership and friendly/helping behaviors. A strong correlation was also found between students' efficacy for learning science and their perceptions of their teachers' cooperative and oppositional behaviors.

These results support previous research that suggests there is an interaction between students' perceptions of teacher interpersonal behaviors and motivation (denBrok, Levy, Brekelmans & Wubbels, 2005; Pianta, 1999; van den Oord & Van Rossem, 2002). In the present study, students who perceived their teachers as helpful, friendly, and understanding were more likely to report high efficacy for science. These results extend the literature on teacher-student interactions and efficacy for learning science; previous studies in science have focused more broadly on student attitudes for learning science. This finding is critical in light of the research indicating the relationship between efficacy and student achievement (Britner & Pajares, 2001;

Britner & Valiante, 2000). In addition, efficacy has been related to other positive student factors such as perseverance in the challenging tasks and value for science (Britner & Pajares, 2001).

Students' perceptions of teacher-student interactions were also predictive of students' task value for science; students who perceived their teachers as helpful, friendly, and classroom leaders reported the highest value for science. These results also support previous findings linking students' value to their classroom interactions (denBrok, Levy, Brekelmans & Wubbels, 2005; Pianta, 1999; van den Oord & Van Rossem, 2002). Value is an integral aspect of the expectancy x value theoretical framing for motivation in the present study (Eccles, 1984; Eccles, Adler, & Meece, 1984; Eccles & Wigfield, 1994; Wigfield, 1994); utility and intrinsic task value can affect students' effort in science as well as their course selection (Cole, Bergin, & Whittaker, 2006; Meece, Wigfield, & Eccles, 1990; Wigfield, 1994).

Results from the present study also indicated that students' perceptions of teacher interpersonal behavior were predictive of their mastery orientation. Research has demonstrated an interaction between a mastery goal orientation and student factors such as intrinsic motivation, persistence with difficult tasks, and healthy attributions for both academic successes and setbacks (Pajares, et al., 2000; Anderman & Young, 1994; Ryan & Pintrich, 1997). Studies have also shown that teachers can be highly influential in fostering the development of mastery goal orientations in their classrooms (Anderman & Young, 1994). The current results resonate with these previous findings; teacher interactions with students were predictive of mastery goal orientations.

Results from this study also indicated that teacher interpersonal behaviors were predictive of students' performance orientation. While this relationship was weaker than the relationships between efficacy, task value, and mastery orientation, it does align with literature suggesting that teacher factors are influential in classroom and individual goal structures (Anderman & Midgley, 1998). Since an increasing emphasis is placed on normative evaluation during the middle grades (Ames, 1992), students may be more likely to develop performance orientations for learning science during this time. The present study indicates that teacher factors can be influential in the formation of these goal orientations, both for mastery and performance goals. These findings highlight the key role of cooperative teacher behaviors in encouraging the development of mastery orientations during the middle grades.

Comparison of group means revealed that there were significant differences between teacher groups; students in a given teacher's class tended to view these teachers' behaviors similarly. Students from Teacher One consistently reported lower efficacy and value for learning science than students from Teacher Two and Three. In addition, students from Teacher One consistently rated their teacher high on oppositional behaviors (e.g. strict, admonishing) and low on cooperative behaviors (e.g. helpful, understanding). This finding suggests that students shared similar perceptions of their science teacher, possibly indicating general teacher behaviors that influence students' motivation either positively or negatively. This is an idea that will be elaborated in detail later in this chapter. It is important to also note that results indicated no significant differences between student perceptions of teacher behavior by ethnicity; no trends emerged in student perceptions as a function of ethnic factors. Only one significant difference was found in gender; female students viewed their teachers as less understanding than their male peers. However, across the other six scales of student perceptions of teacher behavior, there were no other significant differences by gender. Teacher factors, not ethnicity or gender, seem to account for the majority of variance in student perceptions of teacher interpersonal behavior.

Mixing the Data: A Discussion

While previous studies have quantitatively studied aspects of students' perceptions of teacher-student interactions and related motivation, none has followed these statistical analyses up with a qualitative phase. In fact, qualitative literature alone is very limited on constructs related to students' perceptions of teacher-students interaction, and virtually non-existent in its relation to subject-specific motivation. This deficit in the research literature was my primary motivation to conduct this sequential explanatory mixed methods study. Quantitative data alone can identify correlations and statistical relationships, but it cannot offer the richness and personal perspective of qualitative data. Combined, these two methods offer the strength of statistical analysis of survey data from a large student sample and the detailed, in-depth descriptions of student interviews.

In the present study, a sequential explanatory design made it possible to select participants meeting specific criteria and also to develop a deeper understanding of the underlying construction of student perceptions and motivation. Using a participant selection model, I was able to select students who reported high or low motivation for science as well as high or low perceptions of teachers' cooperative behaviors. This approach allowed for an analysis of cases in which motivation and perceptions were positively correlated (in alignment with quantitative results) and also "non-examples" which were not representative of quantitative findings. These interviews provided a context for examining students' construction of perceptions of teacher cooperative and oppositional behaviors as well as a more detailed study of motivational constructs related to science. The semi-structured interview protocol was also revised on the basis of quantitative results in order to follow an explanatory model; constructs that were highly correlated between perceptions and motivation (i.e. teacher helping behavior, understanding behaviors, value for learning science, and efficacy for learning science) became focal points of student interviews.

Interviews also provided an opportunity to gather data from a wide and representative sample of the sixth grade student sample from the quantitative phase. In selecting students from the pool of participants fitting the required criteria (high-high, low-low, high-low, and low-high), the compositions of gender and ethnicity closely mirrored demographics from both the original student sample and the student body as a whole. In this way, a wide variety of student voices were represented and viewpoints from each sixth grade classroom were included in the interview data. The paired student interviews were also effective since this setting helped students to be more comfortable and provided opportunities for students to build on comments from their peers. Further, this paired setting allowed me to engage the students in a dialogue that would not have been possible in single student interviews. Paired interviews also ensured that students did not feel like they were being singled out, an issue that can often be isolating at this pre-adolescent developmental level. Though the paired interviews were originally conducted to comply with district policy, I will use a paired student setting again in future interview research because of the positive benefits noted above.

Discussion of Qualitative Findings

The qualitative phase of this sequential mixed methods study included 24 student interviews which were conducted during a five-day period prior to the beginning of spring standardized testing. During the phase of open coding, the following eleven categories emerged from the interview data: (1) *construction of perceptions of teacher cooperative behaviors: helpful,* (2) *construction of perceptions of teacher cooperative behaviors: understanding,* (3) *construction of perceptions of teacher oppositional behaviors: harsh,* (4) *construction of* *perceptions of teacher oppositional behaviors: impatient*,(5) *construction of perceptions of teacher control*, (6) *efficacy for learning science*, (7) *utility value for learning science: present,* (8) *utility value for learning science: future,* (9) *intrinsic value for science: positive,* (10) *intrinsic value for science: negative,* and (11) *resources selected for challenges*. Of these eleven categories, two concern students' construction of perceptions of teachers' cooperative behaviors (1,2), two categories detail students construction of perceptions of teachers' oppositional behaviors (3,4,) one category describes teachers' classroom control (5), five categories describe aspects of students' motivation for learning science (6,7,8,9,10), and one category details students' strategy selection for confronting difficult tasks in science (11).

In the fashion of a sequential explanatory mixed methods design, the semi-structured interview protocol was designed around the results of the quantitative phase of the study. Consequently, it follows that these themes would be closely related to the themes represented in the survey measures from Phase One of the study. The constructs that remained most intact from the quantitative phase of the study were teachers' cooperative behaviors, oppositional behaviors, and students' value and efficacy for learning science. The original scales for cooperative behaviors from the quantitative measures were partially re-framed in the qualitative data analysis to best interpret students' description of these behaviors. The two categories relating to students' construction of these cooperative behaviors were named helping behaviors and understanding behaviors. The interview protocol focused heavily on these ideas since quantitative results indicated correlations between teachers' helping and understanding behaviors and students' science motivation. Leadership was also found to be highly correlated and was also included in the interview protocol; however, students had difficulty verbalizing their ideas relating to teacher leadership and they generally described these in terms of teachers' helpfulness and understanding behaviors. For this reason, student comments relating to teacher leadership were merged with categories of teacher helpfulness and understanding.

The constructs of mastery orientation and performance orientation are not represented in the categories from the qualitative data analysis. Because these constructs did show significant interactions with students' perceptions of teacher-student interactions, they were included as constructs on the interview protocol. However, students had difficulty reflecting on their primary goals and objectives in science and tended to default to discussions that were more relevant to the constructs of value and efficacy. At times, students mentioned competition in their classroom, but this was not in the context of their goals or underlying drive in science class; they mentioned this aspect of their classroom mostly in reference to other students who were competitive with each other. I can only speculate as to what caused these students to shift the focus away from their goals when these questions were presented. Perhaps the transition to middle school necessitates that students redefine many of their personal and academic goals in response to new demands and responsibilities. This transition could result in an internal disequilibrium as students reassess their identity not only as individuals within the social context, but as students within the academic context. Such a state of internal dissonance could make it difficult for students to verbalize their thoughts in relation to goals in science; perhaps it is easier for students to respond reliably to survey items with clear options than to elaborate on these complex ideas verbally. However, it is also possible that a different slant on the interview protocol could have elicited more student reflection on their goals. Items relating to mastery orientation should be re-evaluated before additional research is conducted with middle school students using the same interview protocol.

From the qualitative analysis, several important observations can be made that directly relate to the qualitative research question: How do middle school science students' perceptions of teacher-student interactions affect domain-specific motivation? Overall, this relationship between students' motivation and their perceptions of teacher-student interactions was challenging to study qualitatively. While young students are able to discuss constructs related to both motivation and perceptions, asking them to make connections between the two is not developmentally appropriate. Prior to conducting the qualitative phase of this study, I discussed this issue at length with a lead researcher in the field of student perceptions of teacher behavior and related motivation. She also agreed that asking students at a sixth grade level to make explicit connections between their motivation and their perceptions of teacher interpersonal behavior was not realistic. Instead, she recommended that this relationship be examined qualitatively by having students reflect on their motivation and perceptions separately; it was then my task to make inferences as to the interaction between these two constructs. In the present study, the analysis of these interactions between student perceptions and motivation occurred during the axial coding phase of qualitative analysis. During this phase, I examined dimensions of motivational constructs and student perceptions of teacher interpersonal behavior in order to draw inferences as to the relationship between these two variables. The following discussion details the primary relationships that emerged from this axial coding phase.

Discussion of Trends Within Sub-Groups

During the qualitative phase of this study, students who reported high motivation and high perceptions of teacher-student interactions during the quantitative phase described the most instances of teacher cooperative behaviors, such as teacher helpfulness and understanding. Not only did these students describe their interactions with their science teachers more positively than students with low motivation, they also described positive interactions in much greater detail. These students reported high efficacy for learning science; they were confident in their abilities to learn science in general and also in their abilities to complete difficult tasks. Students with high motivation tended to rely on their own problem-solving skills and self-reflection when facing these difficult tasks. In addition, students with higher motivation attributed their positive intrinsic value for science to teacher factors, such as personality and support. Students with high motivation and high perceptions of teacher cooperative behavior in science tended to have a positive view of their transition to middle school. They valued the increased responsibility in their science classes and enjoyed the challenge of more in-depth content. These students were also thriving in an environment that encouraged more independence in students. Perhaps these students were equipped with the organizational skills necessary to navigate the unique challenges of middle school (e.g., multiple teachers for multiple subjects, changing classes, managing multiple assignments across different content areas).

Conversely, students reporting low motivation and low perceptions of teacher-student interactions described the most instances of teacher oppositional behavior, such as harsh and impatient behaviors. The majority of these students shared the same science teacher, indicating that teacher behaviors were perceived similarly by students in this low-low group. These students frequently reflected on negative teacher-student interactions with their science teacher and described these interactions in detail. Students with low motivation reported low utility value for science, both in their present daily lives and in the future. These students valued science primarily for grades as a “means to an end” rather than valuing science for its benefits to their current and future lives. Many students recognized that they would need good grades in science in order to pursue other goals, such as playing college sports. In addition, these students were not confident in their abilities to learn science or to complete difficult tasks in science.

Students with low motivation and low perceptions maintained a general negative intrinsic value for science and attributed their feelings to teacher behaviors such as giving excessive work and getting angry when students ask questions. Interestingly, these students reported that their primary strategy for approaching difficult tasks in science was to seek teacher help. These students did not mention using any of the problem-solving skills and self-reflective strategies cited by the students reporting high motivation. Perhaps these students' increased reliance on their teacher for assistance contributed to differing expectations than students who required less teacher guidance. Students reporting low motivation for science were more negative about their transition to middle school. While students with high motivation viewed added responsibility as an opportunity for more independence, student with low motivation tended to be overwhelmed by increased workloads and new teacher expectations. These students frequently mentioned the fact that their middle school science teachers did not do as much to help them with organization and expected them to keep track of more due dates and assignments. In general, students with low motivation for science were experiencing more difficulty with managing the structure and increased independence of middle school. Again, it is important to note that these students were primarily from the same science teacher's classes; perceptions of this teacher's behavior were consistent across this group of low-low students within students from the same science teacher. This indicates that teacher behaviors may be perceived similarly by students, possibly pointing to general teacher behaviors that affect student motivation.

In an effort to examine all extremes of motivation and student perceptions of teacher interpersonal behaviors, I also interviewed students who reported high motivation for science and low perceptions of teacher-student interactions. These students were representative of an opposing hypothesis: students' perceptions of teachers' interpersonal behaviors do not necessarily predict student motivation. In this case, there were other factors at play, representing an important alternative scenario. If research examines only the data that support a given hypothesis, the opportunity to learn from non-examples is lost. In this study, students who reported high motivation and low perceptions generally talked more positively about their teachers than they had reported on the survey instruments. One possible explanation is that these students did not want to talk in a negative light about their teachers due to a desire to present a positive scenario of their classroom environment for the researcher. However, it is also possible that these students' differing responses to survey items were situational. For example, if a student was angry with their teacher the day they took the quantitative survey, this could have swayed their results on that given day, even if those responses were not representative of their overall perceptions of interactions with their teacher.

Students with high motivation and low perceptions (reported from the quantitative phase) had two primary distinctions from the high-high interview group. First, high-low students reported less future and present utility value for science than high-high students. While students in the high-high group described multiple aspects of future utility value for science, students in the high-low group cited only the value of science for students who plan to enter a science career. Secondly, students in the high-low group were more reliant on peers and their teacher for assistance when approaching difficult tasks in science. As discussed in reference to the low-low group, it is possible that more reliance on teacher assistance and guidance could result in students developing higher expectations of teacher, thus affecting their perceptions of their teacher's helpfulness and understanding if teachers are not able to meet these elevated expectations or provide a means for students to modify them.

I also conducted interviews with students reporting low motivation and high perceptions of teacher-student interactions. This group is also representative of the following opposing hypothesis: students' perceptions of teachers' interpersonal behaviors do not necessarily predict student motivation. In this case, students who reported very favorable perceptions of their teachers' cooperative behaviors still reported low motivation for learning science. This group aligns with idea that motivation is a multi-dimensional construct composed of a variety of internal and external factors. These students reported low utility value for science and an over-all apathetic interpretation of their efficacy for science. Students from this low-high group reported a negative intrinsic value for science, but were favorable about interactions with their science teacher. Overall, these students did not find science interesting and were also apathetic about their transition to middle school. Unlike students in the low-low group, these students did not attribute their negative intrinsic value for science to their teacher; they reported the actual content of science was boring and not relevant to their daily lives or their future. In terms of strategies for approaching difficult tasks, these students generally completed what they understood and then would sometimes ask for help from their teachers. However, students' comments led me to believe that these students were not engaged in the class and tried to remain inconspicuous in the classroom. While many students in the low-low group reported frequent negative teacher attention (e.g., being corrected for discipline issues), students in the low-high group described few actual interactions with their teachers. The overarching sentiment within this group was apathy for science, and school in general.

Discussion of Overall Findings

The current study followed a sequential explanatory mixed methods design. Though one point of data mixing occurred during the participant selection model, an interpretative analysis of overall findings from the quantitative and qualitative data was also necessary to fully understand the results of this study. Cresswell and Plano-Clark (2007) provide several questions to guide this process: “To what extent do the quantitative and qualitative data converge? How and why? To what extent do the same types of data confirm each other? To what extent do the open-ended themes support the survey results? What similarities and differences exist across levels of analyses?” (Creswell & Plano-Clark, 2007, p. 137). These questions are discussed below.

To what extent to the quantitative and qualitative data converge?

Students who reported high motivation and high perceptions during the quantitative phase also reported high motivation and high perceptions during the qualitative phase of the study. These students’ comments during the qualitative interview aligned with their responses on survey items in relation to the efficacy, task value for science and high perceptions of teachers’ cooperative behaviors. These students provided detailed descriptions of their teachers’ helpful and understanding behaviors, consistent with the quantitative results. In addition, these students described high efficacy for learning science, high utility value for both the present and the future, and high intrinsic value for learning science. In addition, these students attributed many aspects of their efficacy for learning science and their intrinsic value for science to their teachers. These qualitative results align with quantitative results that students’ perceptions of teacher cooperative behaviors were predictive of student motivation in science.

Students who reported low motivation and low perceptions during the quantitative phase also reported low motivation and low perceptions during the qualitative phase of the study.

During the interviews, these students' comments aligned with their responses on survey items in relation to their efficacy, task value for science and low perceptions of teacher's cooperative behaviors. These students described their teachers' behavior as harsh, impatient, and controlling; these sentiments aligned with students' responses on the survey measures. In addition, these students reported low efficacy for learning science and low utility and intrinsic value for science. As with the high-high group, these qualitative results align with quantitative results that students' perceptions of teacher cooperative behaviors were predictive of student motivation in science.

In order to ensure that alternate viewpoints were represented, I also interviewed students whose motivation for science and teacher perceptions presented the opposing hypothesis. In the high-low interview group, students had indicated high motivation for science and low perceptions of teacher behaviors on the survey measures. These students' comments in the interviews aligned with their reports of high motivation for science; they indicated high efficacy for science and high task value, though lower than the high-high group. However, these students tended to describe their teachers' behaviors more positively in the interviews than they did in the surveys. One possible explanation for this is the difference in context between the two phases; the quantitative surveys were anonymous and the interviews were more personal in nature. Several students expressed concern about their answers and their teacher's job and if their answers would be shared with their teacher. Although I assured students that their answers during the interviews were confidential and would not affect their teacher in any way, I can imagine that sixth-grade students would still have some level of anxiety about how they describe their teacher.

In the low-high interview group, students had indicated low motivation for science and high perceptions of teacher behaviors on the survey measure. These students' comments about their motivation for science and their teachers' behavior aligned with their survey results. Students in this group reported low efficacy and low task value as well. Students were generally positive regarding their interactions with their teachers, describing them as helpful and understanding. However, these students described fewer one-on-one interactions with their teachers than students in any other group. These students tended to keep a low profile in the class and "get by" the best they could. They generally did not go to their teacher for help, but preferred to figure problems out on their own, for better or for worse. It is possible that the students with a low-low profile had higher expectations of their teachers to provide one-one-one assistance when they were facing challenges or difficult tasks in science. Perhaps students in the low-high interview group, who do not rely on their teacher for help as often, would have different expectation of their teacher, thereby affecting their perceptions of teacher interpersonal behavior.

Another important point of alignment between the quantitative and qualitative data was consistency within groups of students sharing the same science teacher. In the quantitative analysis, there was a significant difference between students from Teacher One and students from Teacher 2 and 3 in perceptions of teacher interpersonal behavior and motivation for learning science. This result indicates that students generally perceived their teachers' interpersonal behavior similarly. Students from Teacher One tended to view their teacher as less helpful, less understanding, more strict, and more admonishing than students from Teacher Two and Three. In addition, students from Teacher One also reported less efficacy for learning science and less value for learning science than students from Teacher Two and Three. In other words, there were not significant differences between students' perceptions and motivation within students sharing the same teacher. This result implies that students generally perceived their teachers in similar ways. Qualitative results were also consistent with these quantitative findings. During student interviews, the majority of students with low motivation and low perceptions of teacher interactions shared the same science teacher. These results imply that there may be general teacher behaviors that are perceived similarly by students. For example, students in the current study generally viewed teacher propensity to anger quickly as a negative behavior and were more likely to report low motivation and low perceptions if their teacher had a quick temper. Likewise, students tended to be consistent in their reports of teacher patience and empathy as positive behaviors and influential in their intrinsic value for science. When these results are also considered in light of non-significant differences between ethnic groups, it is possible to hypothesize that students may be quite similar in the ways that they interpret teacher behaviors. Perhaps teachers do not need to differentiate their interpersonal behaviors to address the needs of various groups of students, but rather focus on general aspects of cooperative behavior that will benefit student perceptions as a whole.

To what extent do the themes support the survey results? What similarities and differences exist across levels of analyses?

Qualitative themes developed from Phase Two interview data were generally in alignment with constructs represented in the Phase One scales from the revised PALS and QTI instruments. However, several differences emerged during the qualitative analysis. These quantitative scales and qualitative themes are compared in Figure 5.1.

Figure 5.1

Comparison of Quantitative Scales and Qualitative Themes

	Quantitative Scales	Qualitative Themes
QTI Scales: Coop	(1) Perceptions of Teacher: Leadership	(1) Construction of Perceptions of Teacher Cooperative Behavior: Helpful
	(2) Perceptions of Teacher: Helpful/Friendly	
	(3) Perceptions of Teacher: Understanding	(2) Construction of Perceptions of Teacher Cooperative Behavior: Understanding
	(4) Perceptions of Teacher: Student Responsibility	(3) Construction of Perceptions of Teacher Control
QTI Scales: Opp	(5) Perceptions of Teacher: Strict	
	(6) Perceptions of Teacher: Admonishing	(4) Construction of Teacher Oppositional Behavior: Harsh
	(7) Perceptions of Teacher: Dissatisfied	(5) Construction of Teacher Oppositional Behavior: Impatient
PALS Scales	(1) Efficacy for Learning Science	(6) Efficacy for Learning Science

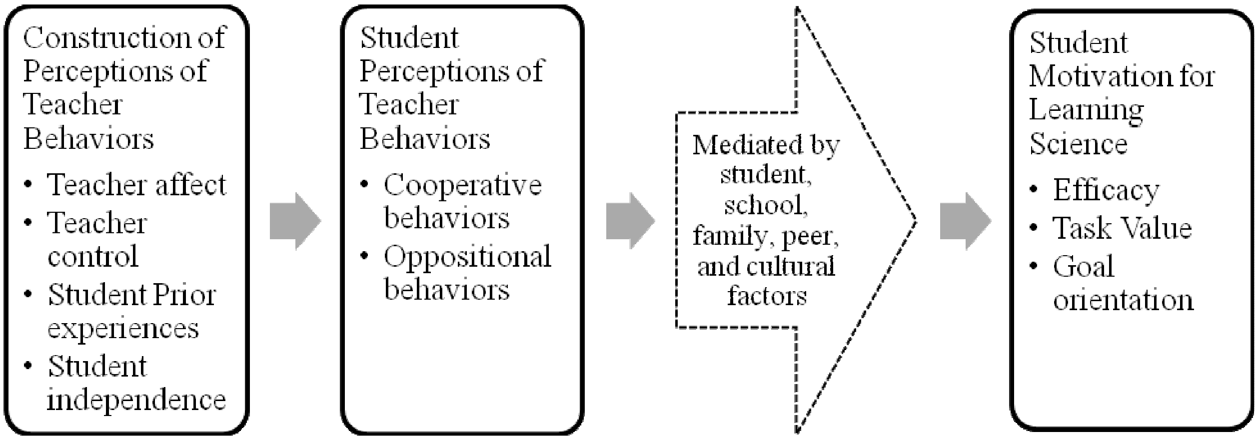
	(2) Mastery Orientation	
	(3) Performance Orientation	
Task Value Scale	(4) Task Value for Learning Science	(7) Utility Value: Present
		(8) Utility Value: Future
		(9) Intrinsic Value: High
		(10) Intrinsic Value: Low
		(11) Resources Selected for Challenges

During the quantitative phase, students selected their level of agreement with statements regarding aspects of teacher behavior. During the qualitative interviews, students expounded on these behaviors, describing the process by which they constructed these perceptions of teacher behavior. In addition, during the quantitative phase, students reported their level of agreement with statements related to their efficacy, task value, and goal orientations for learning science. During the qualitative phase, students described factors affecting their efficacy for science and talked in-depth about their value for science. From these interviews, the levels of utility and intrinsic value for science emerged, constructs that were not initially expected. A category also emerged from the qualitative data that was not represented in the survey: resources selected for challenges. This category contributed to an understanding for how students approach difficult tasks in science and how this construct relates to their motivation for science and perceptions of teacher interpersonal behavior. As discussed earlier, mastery and performance orientations were not represented in the themes from the qualitative data. Though these constructs were included in the interview protocol, students did not respond to these questions in relation to their goals for science. Their responses to these questions were more aligned with concepts of efficacy for science and task value and were coded accordingly. While the quantitative phase allowed a broad look at student motivation and perceptions of teacher interpersonal behavior, the qualitative interviews provided for a detailed examination of construction of perceptions and subcategories of student motivational constructs.

An interpretation of results from the quantitative and qualitative phases of this study provides the basis for a hypothetical model of student science motivation in relation to teacher interpersonal behavior. This model was developed by a merged interpretation of the findings of both phases of this mixed methods study. While still in its developing stages, it provides a visual representation of findings from this study as well as a guide for future research on students' science motivation. This model is presented in Figure 5.2.

Figure 5.2

Visual Model of Student Science Motivation and Teacher Interpersonal Behavior



Theoretical Implications

The current study identified a predictive relationship between students' perceptions of teacher interpersonal behavior and their efficacy for learning science. Bandura (1977, 1997) theorized that several key experiences contribute to an individual's self-efficacy for any given domain. These areas include mastery experiences, vicarious experiences, social persuasion, and physiological states. Social persuasion is especially relevant to the current study and its focus on teacher-student interactions. The teacher is often a powerful source of social persuasion for students; teachers who communicate positive messages to students about their abilities can foster an increase in the students' self-efficacy. However, Bandura (1977, 1997) postulated that it is easier for social persuasion to decrease an individual's self-efficacy for a task than to increase it. Consequently, when students receive negative appraisals of their ability from their teacher, their self-efficacy can suffer more than it might increase with a positive appraisal. In the current study, many students who reported low efficacy for science also reported negative interactions with their teachers, often noting teacher dissatisfaction when students did not understand concepts. When students receive negative feedback in conjunction with confusion about science concepts, their self-efficacy may suffer. In the current study, students who reported high efficacy for learning science also discussed positive interactions with their teachers, such as verbal encouragement and specific support in understanding science concepts. In light of Bandura's concept of social persuasion, it is possible that teachers play a pivotal role in helping to foster students' efficacy for learning science when their interactions are perceived positively, but play an even stronger role in contributing to a decrease in student efficacy when their interactions are perceived negatively.

Research indicates that students' task value can be predictive of their achievement, course selection, and effort (Cole, Bergin, & Whittaker, 2006; Meece, Wigfield, & Eccles, 1990; Wigfield, 1994). In the current study, students' perceptions of their teachers' interpersonal behavior were predictive of their task value for science. Students who reported positive interactions with their teachers also reported high task value for science. Conversely, students reporting negative interactions reported low task value for science. Qualitative interviews revealed the dimensions of utility and intrinsic value; students discussed both the usefulness of science in their lives and their enjoyment of science. Interestingly, students who reported a high utility value for science generally also reported a high intrinsic value for science, and vice versa. In other words, students who saw the value of science in their daily lives or for the future also enjoyed science as well. This finding raises the following question: Does utility value influence intrinsic value or it is the other way around? For example, do students enjoy science because they see the usefulness of the subject, or do they see the usefulness of science because they enjoy it? The other side of this question is more daunting: Do students dislike science because they do not see its usefulness, or do they fail to see the usefulness because they dislike the subject? Perhaps the relationship between these two forms of task value is reciprocal, with each exerting influence on the other. This relationship between students' utility value and intrinsic value for science could be explored in future studies.

In the current study, there was a significant relationship between students' perceptions of teacher-student interactions and motivation. However, some students did not align with these statistical findings. During the qualitative interviews, I made an effort to represent students who reported low motivation and high perceptions of teacher-student interactions and vice versa. Even though these students reported high perceptions of teacher-student interactions in the classroom, they still reported low efficacy and value for learning science. Bronfenbrenner's Ecological Model (1977) contextualizes the role of teacher-student interactions in relation to a variety of additional factors affecting student outcomes. This suggests that other factors were more influential in the low motivation-high perceptions group's motivation for learning science than their perceptions of teacher-student interactions. Perhaps factors in the microsystem such as family or peers were affecting these students' motivation for learning science. Cultural factors embedded within the influence of the macrosystem could also have exerted influence on these students' motivation for learning science. The important conclusion to draw from this theoretical model is that a variety of factors can affect student motivation. While the current study indicates that teacher-student interactions are a critical piece in the development of student motivation for learning science, a wide array of family, peer, and cultural factors are also at work to influence student motivation. Bronfenbrenner's model provides a framework for discussing these factors and considering the complex web of forces affecting student motivation.

Implications for Middle Grades Science Education

The most critical implication for middle grades science educators from the current study is the potential that teachers have to affect elements of student motivation for learning science. Though we cannot say that teachers' interactions necessarily influence motivation for all students in all contexts, teachers should nevertheless develop an awareness of the way in which their interactions with students might shape student efficacy for learning science and their value for the subject. Students in the current study indicated an acute awareness of their teachers' cooperative behaviors. Conversely, students were also aware of teacher impatience and frustration when students didn't understand content; these negative interactions most often were perceptions of students who had low intrinsic value regarding science and a lack of confidence for their abilities to be successful in science. Considering the strong relationship between teachers' interactions and student motivation in science, teachers should be cognizant of the ways that they interact with their students. Students generally interpret tight classroom control, teacher propensity to anger quickly, and unwillingness to listen as negative teacher behaviors. Alternately, students generally perceive availability, approachability, and individual attention as positive teacher behaviors. In other words, students are more likely to discuss high motivation for science when they feel that their teacher is patient and willing to take the time to listen to their individual needs.

Though these conclusions may seem intuitive, the importance of developing positive interactions with students is often overlooked in classrooms where the teacher's main focus is covering standards and producing high test scores. This point is not intended to criticize teachers for becoming narrowly focused on student performance; the stress of these expectations often has its source at an administrative and district level. However, the stress and frustration that teachers feel in response to these demands have the potential to affect student motivation negatively if they are communicated in the context of classroom interactions. In the same way that teachers need to be reflective of their instructional practices in relation to standards and academic goals, they also need to reflect on the ways that they are personally interacting with individual students. Students are keenly aware of their teachers' affect and are sensitive to nuances in classroom interactions. Despite their youth, middle school students are insightful and susceptible to the effects of both positive and negative interactions with their teachers.

The current study also indicates that students' prior experiences in elementary grades may affect their expectations of teachers and therefore their perceptions of teacher-student interactions in the middle grades. Coming into middle school, some students have developed strong problem-solving skills that allow them to be more independent and less reliant on teacher assistance in confronting difficult tasks. This may cause these students to have different expectations of their teacher, possibly resulting in different perceptions of teacher behavior than students who lack skills for working independently. It is difficult to identify the mechanisms that precipitate the development of these more self-reliant behaviors; however, students who possess these skills seem to perceive their teachers differently from students who are more dependent on teacher assistance. Students who report low motivation for science tend to be the most reliant on teacher help and also the most critical of their teachers for not providing this needed assistance. Ironically, these students' perceptions of their teachers as harsh and unapproachable lead them to abandon their primary strategy for dealing with complex tasks, asking for teacher help. This cycle can leave students with low motivation with limited strategies for dealing with difficult tasks, thereby raising the probability that they will experience failure on these tasks. In order for efficacy to increase, students need to experience small successes (Bandura, 1977,1997) ; these successes may be especially critical for students with low motivation and low efficacy for science. Thus, it is problematic when students with low motivation perceive their teachers as unapproachable and abandon their primary success strategy, that of seeking help from the teacher.

Students with low motivation constructed their negative perceptions of teacher interpersonal behavior primarily through their views of their teacher as easily angered, unfair, and unwilling to listen. These descriptions highlight the importance of teacher control philosophies and how teachers convey varying levels of control to their students. Teachers who are more authoritarian tend to maintain a tight rein on all aspects of the classroom. This can include enforcing procedures, controlling the pace of the lesson, and restricting student movement and active involvement. Previous studies have indicated that students often perceive these authoritarian teacher control styles negatively (Brophy, 1996; Tollefson, 2000). When considering the primary aspects of oppositional teacher behaviors that students cited in the present study (anger, unfairness, lack of listening), it is conceivable that these characteristics could be indicative of an authoritarian system of classroom management. Student-centered classroom management models are correlated with more positive student judgments of interactions with their teachers (Lewis, Romi, Qui, & Katz, 2005). Students report positive interactions with a teacher who is approachable, fair, in control without being authoritarian, engaging, and interested in student ideas and points of view. In-service training and professional development in student-centered classroom management models could help to increase teachers' awareness of the way in which their management style can affect student perceptions and consequently, their motivation.

Across all sub-groups, students discussed the value of science for their present lives and their future lives. Consistently, students did not connect their current science learning with their future personal career goals, even though they could verbalize the importance of science for *others* pursuing future science careers. Students tended to view science as important for *others* who intended to pursue a science career. However, in reference to their own future goals, students reported that they would “learn that later” in describing the skills they would need in science-related fields. Current Education and Economic Development Act (EEDA) legislation calls for students to identify a career path early in their K-12 education and to structure high school coursework around these career goals. The current study indicates that students need additional scaffolding within their science classes in order to see the explicit connections between the science content and their career options. While students can see science in general as applicable to other students who wish to pursue careers in science, they have difficulty identifying personal goals with current science concepts. Instead, students need to see science as a foundational aspect of their growth towards careers. Cooperative behaviors, especially understanding and listening, give teachers the opportunity to listen to student ideas about science and find ways to help students make personal connections to science in relation to future career goals. Perhaps at this sixth grade developmental level, students need teachers to make more explicit connections between specific aspects of science content and career opportunities.

In addition to connections to future science careers, students also need to be able to make connections between science content and their lives as future citizens. Helping students at the middle school level to make connections between science and their future roles in society could raise their perceptions of the future value of science. Students who reported low motivation in the present study did not see the direct relevance of science for their future. Though teachers may discuss “real-world connections,” students are not making the leap between these connections and their daily lives and futures. Making these connections more explicit could have a positive influence on students’ value for science and, consequently, their motivation.

The transition to middle school also has implications for both student motivation and teacher-student interactions. Students who were adjusting well to the transition to middle school with increased responsibility and expectations generally reported high motivation for science; students who were struggling with this transition tended to report low motivation. All students reported an awareness of an increase in difficulty and expectations in middle school science. Students who were equipped with organizational skills for managing multiple teachers and classes experienced a positive transition and higher motivation for science. Students who lacked these skills for organization and coping were in need of additional scaffolding. Teachers have the ability to scaffold this transition; cooperative teacher behaviors may help students to make this transition more smoothly. Students who were struggling with this transition to middle school did not perceive their teachers as supportive, helpful, or understanding. Perhaps some middle school teachers help students to gradually make this transition while others expect students to “sink or swim.” Developmentally and academically, sixth grade is a challenging time for students. They are surrounded by new peers, teachers with multiple classes of students, lockers, changing classes, social pressures, and increased workloads. Perhaps additional supports from teachers and guidance staff could help all students to navigate this transition, especially those students who need additional assistance in developing personal skills necessary for success in middle grades.

Implications for Science Teacher Education

The current study also has implications for science teacher education, especially in relation to the role of the teacher in science instruction. In the current study, students expressed a desire for an active role in the science classroom and valued teacher behaviors that respected their opinions and viewpoints. Students need and want a voice in the science classroom. When teachers are the primary focus of instruction, such as during lectures, they are less likely to give students an active role in processing and making sense of information. Students who reported high motivation for science also discussed the opportunities for responsibility and choice in their science classroom. Teachers may benefit from a study of the role of the teacher and the role of students in various instructional approaches.

The first content strand in the National Science Education Standards (NRC, 1996) addresses unifying concepts of science processes and content and is followed by the strand Science as Inquiry. Inquiry-based instruction engages students in the learning process as they explore science content and actively process meaning. Characteristics of teacher-student interactions that were positively related to students' motivation in science align with key elements of inquiry-based instruction. For example, students perceived their teachers as helpful and patient when they provided scaffolding in the form of guiding questions and individual support as students grappled with difficult science concepts. One student described this guidance from her teacher during a class discussion:

> Like when you don't know, and you take like ten seconds she won't pick on someone else, she'll stick with you. I mean, she's stayed with people for like two and three minutes before. I mean she sort of eases them closer to the answer and when they finally get the answer, then she goes and recaps like, 'How did you get that answer?'

In this example, the teacher utilized follow-up questioning to guide an individual student to develop an understanding of a concept in science; this process represents a key element of inquiry-based instruction in which students actively engage in making meaning of science concepts. This process requires teachers to be patient with students as they develop a conceptual understanding of science concepts with the teacher acting as a guide. Cooperative teacher interpersonal behaviors align with the facilitative role of the teacher in inquiry-based instruction supported by NSES standards (NRC, 1996). Oppositional teacher behaviors (e.g., admonishing, impatient) inhibit the teacher from interacting with students in a way that facilitates their progressive, scaffolded construction of meaning in science.

This study also provides implications for behavior management pre-service training for teachers, especially training in student-centered models of management. Students in the current study reported low motivation in relation to oppositional teacher behaviors. Management models that adhere to tight teacher control of classroom procedures and lead teachers to take class time to address small items that are not disrupting instruction often lead students to construct perceptions of the teacher as harsh and impatient. These perceptions make it less likely that the students will approach the teacher with items that they do not understand. In addition, this authoritarian style of management makes it less likely that students will have the opportunity to seek help from peers and interact freely with each other.

Limitations

There are several key limitations to this study. First is the issue of self-report data in the survey phase of this study. Though children as young as eight years old have accurately reported data on attitudes measures (Alderman, 2004), there is always a concern that self-report data may not be truly representative of the participants' actual motivation, perceptions, etc. In addition, the length of the survey measures could have resulted in fatigue factors for some students in the study. However, as described in Chapter Three, revisions in the instrumentation were a direct result of this possible concern and shortened versions were a more appropriate length for the developmental level of the participants.

Perhaps one of the most critical limitations to this study was the sensitive nature of the topic. Asking students to report their perceptions of teacher behaviors can be sensitive not only for students but also for teachers. My original plan was to include two middle school academies with a total of six science teachers, 24 science classrooms, and around 500 students. However, when I shared the survey instruments with teachers during the process of securing permissions at all levels, several teachers opted not to participate in the study. These teachers declined because they did not feel comfortable with their students reporting their perceptions of classroom interactions. One teacher also felt that students were not capable of reporting perceptions of their teachers. Though I tried to talk to teachers about the central intent of the study, factors influencing students' science motivation, several teachers were afraid that results could reflect negatively on them. In the end, I lost three teachers, 12 science classrooms, and over 200 student participants because of these concerns. Though this was a setback to my original research plan, I respected these teachers' feelings and realized that their decision came from real anxiety about their participation in the study. However, this could potentially bias the results of the current study and similar studies, resulting in an over-representation of teachers who are confident in their interactions with their students and therefore willing to participate.

This raises a legitimate concern in this line of research; how do we adequately represent students' perceptions of teacher interpersonal behavior when their participation is limited by their teachers? In discussions with other researchers who pursue similar lines of research, I have discovered that many of them have encountered similar opposition from teachers, but rarely school administrators or parents. The three teachers who chose to participate in the study were very interested in the results, shared anonymously, and were anxious to use these results to inform their teaching practice. I had the opportunity to have many engaging discussions with these three teachers about their own perceptions of their interactions with students and how they would use results from this study to be more aware and reflective about their interactions as well as factors that can affect students' motivation to learn science. In this potentially sensitive line of research, it is critical to open communication lines with teachers early, listen to any anxieties they may have, and minimize any threat that teachers may feel about their students reporting their perceptions of classroom interactions.

Future Research Directions

The current study represents a step in advancing the current line of research in students' perceptions of teacher interpersonal behavior and related subject-specific motivation. Since few studies have included a qualitative component to study the interactions between these constructs, the present study is a step towards extending this line of research beyond purely quantitative measures. However, the current interview protocol should be refined in future studies to include more effective items for addressing students' goal orientations. In the current study, interview questions designed to address mastery and performance goal orientation were not successful in facilitating a discussion of these constructs. In addition, further consideration should be given to developing more direct lines of questioning to encourage students to reflect more explicitly on the relationship between motivation and teacher-student interactions. In the present study, experts in the field also expressed uncertainty about how best to address this relationship with young students. It would be useful to develop a framework for interpreting students' interview data relating to motivation and teacher-student interactions in order to establish a standard for analyzing interview data when researchers must make interpretations about the relationships between these two variables. The current study, in conjunction with related research, could be a beginning point for the development of an interpretive framework for student interview data in this line of research.

Future research in other domains would also contribute to the study of how motivation may differ across subject areas. For example, how predictive are students' perceptions of teacher-student interaction of their math motivation? Do interactions between motivation and teacher-student interactions vary across content areas or do results generalize to other domains? Are survey instruments, such as the QTI and PALS, more reliable in some domains and less reliable in others? These questions could contribute to our knowledge of the dimensions of student motivation and how this construct differs according to variables related to student, teacher, and domain.

I also plan to do additional research using the revised versions of the QTI and PALS instruments as well as the Task Value Scale. Refinement of these instruments may open doors for conducting additional reliable and valid survey research in these areas with middle grades and possibly younger students. In addition, the rephrasing of items from British to American English and reorganization of scale items could improve the reliability and validity of these measures with US populations.

Student motivation for learning science is a complex construct. This study is one of the first of its kind to examine efficacy, task value, and goal orientations in relation to teacher interpersonal behavior with middle grades students. The results of this study indicate a significant relationship between students' motivation for learning science and teacher interpersonal behavior. However, this is one piece in a complex web of factors affecting student motivation for learning science. Previous research indicates that teacher-student interactions are mediated by a host of other factors, including student factors, peer factors, family factors, school factors, and cultural factors (Bronfenbrenner, 1977; Pianta, 1999). Future research into the impact of these factors upon student motivation for science in the middle grades is critical to developing a more comprehensive understanding of how to facilitate and support student motivation during middle school and beyond. Since motivational patterns can remain stable after the middle grades, this is a critical time to support students' efficacy for science, task value for science, and optimal goal orientations. However, results from the current study provide evidence of a potentially powerful relationship between teacher-student interactions and these important components of motivation for learning science.

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Appendix A

Questionnaire on Teacher Interaction (QTI)

This questionnaire asks you to describe the behavior of your teacher. This is NOT a test. Your opinion is important.

This questionnaire has 48 sentences about the teacher. For each sentence, circle the number that matches your response. For example:

	Never				Always
The teacher expresses himself/herself clearly.	0	1	2	3	4

If you think that your teacher always expresses himself/herself clearly, circle the 4. If you think your teacher never expresses himself/herself clearly, circle the 0. You can also choose the number 1, 2, and 3 which are in-between. If you want to change your answer, cross it out and circle a new number. Thank you for completing this survey!

Teacher's Name: Class Period: School: ID #:

	Never				Always
1. This teacher talks enthusiastically about his/her subject.	0	1	2	3	4
2. This teacher trusts us.	0	1	2	3	4
3. This teacher seems uncertain.	0	1	2	3	4
4. This teacher gets angry unexpectedly.	0	1	2	3	4
5. This teacher explains things clearly.	0	1	2	3	4
6. If we don't agree with this teacher, we can talk about it.	0	1	2	3	4
7. This teacher is hesitant.	0	1	2	3	4
8. This teacher gets angry quickly.	0	1	2	3	4
9. This teacher holds our attention.	0	1	2	3	4
10. This teacher is willing to explain things again.	0	1	2	3	4
11. This teacher acts as if he/she does not know what to do.	0	1	2	3	4
12. This teacher is too quick to correct us if we break a rule.	0	1	2	3	4
13. This teacher knows everything that goes on in the classroom.	0	1	2	3	4
14. If we have something to say, this teacher will listen.	0	1	2	3	4
15. This teacher lets us boss him/her around.	0	1	2	3	4
16. This teacher is impatient.	0	1	2	3	4
17. This teacher is a good leader.	0	1	2	3	4
18. This teacher realizes when we don't understand.	0	1	2	3	4
19. This teacher is not sure what to do when we fool around.	0	1	2	3	4
20. It is easy to pick a fight with this teacher.	0	1	2	3	4
21. This teacher acts confidently.	0	1	2	3	4
22. This teacher is patient.	0	1	2	3	4
23. It's easy to make this teacher look foolish.	0	1	2	3	4
24. This teacher is sarcastic.	0	1	2	3	4
25. This teacher helps us with our work.	0	1	2	3	4
26. We can decide some things in this class.	0	1	2	3	4
27. This teacher thinks we cheat.	0	1	2	3	4
28. This teacher is strict.	0	1	2	3	4
29. This teacher is friendly.	0	1	2	3	4
30. We can influence this teacher.	0	1	2	3	4
31. This teacher thinks that we don't know anything.	0	1	2	3	4
32. We have to be silent in this teacher's class.	0	1	2	3	4
33. This teacher is someone we can depend on.	0	1	2	3	4
34. This teacher lets us fool around in class.	0	1	2	3	4
35. This teacher puts us down.	0	1	2	3	4
36. This teacher's tests are hard.	0	1	2	3	4
37. This teacher has a sense of humor.	0	1	2	3	4
38. This teacher lets us get away with a lot in class.	0	1	2	3	4
39. This teacher thinks that we can't do things well.	0	1	2	3	4
40. This teacher's standards are very high.	0	1	2	3	4
41. This teacher can take a joke.	0	1	2	3	4

42. This teacher gives us a lot of free time in class.	0	1	2	3	4
43. This teacher seems dissatisfied.	0	1	2	3	4
44. This teacher is tough when grading papers.	0	1	2	3	4
45. This teacher's class is pleasant.	0	1	2	3	4
46. This teacher is lenient.	0	1	2	3	4
47. This teacher is suspicious.	0	1	2	3	4
48. We are afraid of this teacher.	0	1	2	3	4

Appendix B

Patterns of Adaptive Learning Survey

The following scales were selected from the complete PALS instrument for measures of student motivation in the present study. When these PALS scales are administered to students, the following items will not be divided into separate scales, but will be randomly combined into one survey.

Students respond to the items below using the following Likert scale:

Not at all true		Somewhat true		Very true
1	2	3	4	5

Revised Mastery Orientation Scale (Domain-specific: Science)

It’s important to me that I learn a lot of new science concepts this year.

One of my goals in science class is to learn as much as I can.

One of my goals is to master a lot of new skills in science this year.

It’s important to me that I clearly understand my science class work.

It’s important to me that I improve my skills in science this year.

Revised Performance-Approach Scale: (Domain-specific: Science)

It’s important to me that other students in my science class think I am good at my class work.

One of my goals is to show other that I’m good at my science class work.

One of my goals is to show others that science class work is easy for me.

One of my goals is to look smart in comparison to the other students in my science class.

It’s important to me that I look smart compared to others in my class.

Revised Performance-Avoid Scale (Domain-specific: Science)

It’s important to me that I don’t look stupid in class.

One of my goals is to keep others from thinking I’m not smart in science class.

It’s important to me that my teacher doesn’t think that I know less than others in my science class.

One of my goals in class is to avoid looking like I have trouble doing the work.

Academic Efficacy Scale (Domain-specific: Science)

I’m certain I can master the skill taught in science this year.

I’m certain I can figure out how to do the most difficult class work.

I can do almost all the work in science class if I don't give up.
Even if the work is hard, I can learn it.
I can do even the hardest work in this class if I try.

Relevance of School for Future Success (Domain-specific: Science)

If I do well in science, it will help me have the kind of life I want when I grow up.
My chances of succeeding later in life depend on doing well in science.
Doing well in science improves my chances of having a good life when I grow up.
Getting good grades in science will help me get a good job when I grow up.
If I am successful in science, it will help me fulfill my dreams.
Doing well in science will help me have a good career when I grow up.

Appendix C
Revised Motivation Measure

Patterns of Adaptive Learning Scales + Value Scale

Race: African-American Caucasian Latino Asian-American
Other ___________________

Gender: Female Male

Part One

1. It's important to me that I learn a lot of new things in science this year.

Strongly Disagree Disagree Somewhat Disagree Somewhat Agree Agree StronglyAgree

2. I want to keep others from thinking I'm not smart in science class.

Strongly Disagree Disagree Somewhat Disagree Somewhat Agree Agree StronglyAgree

3. Learning science is important.

Strongly Disagree Disagree Somewhat Disagree Somewhat Agree Agree StronglyAgree

4. I can figure out how to do difficult class work in science.

Strongly Disagree Disagree Somewhat Disagree Somewhat Agree Agree StronglyAgree

5. I want to master a lot of new skills in science this year.

Strongly Disagree Disagree Somewhat Disagree Somewhat Agree Agree StronglyAgree

6. Science in an important subject.

Strongly Disagree Disagree Somewhat Disagree Somewhat Agree Agree StronglyAgree

7. I want to show others that science class work is easy for me.

Strongly Disagree Disagree Somewhat Disagree Somewhat Agree Agree StronglyAgree

8. It's important to me that I clearly understand my science class work.

Strongly Disagree Disagree Somewhat Disagree Somewhat Agree Agree StronglyAgree

9. Even if the work is hard, I can learn it.

Strongly Disagree Disagree Somewhat Disagree Somewhat Agree Agree StronglyAgree

10. It's important to me that I look smart compared to others in my class.

Strongly Disagree Disagree Somewhat Disagree Somewhat Agree Agree StronglyAgree

11. I can master the skills taught in science this year.

Strongly Disagree Disagree Somewhat Disagree Somewhat Agree Agree StronglyAgree

12. It is important for me to learn science.

Strongly Disagree Disagree Somewhat Disagree Somewhat Agree Agree StronglyAgree

13. I don't want others to think I have trouble doing class work in science.

Strongly Disagree Disagree Somewhat Disagree Somewhat Agree Agree StronglyAgree

14. It's important to me that other students in my science class think I am good at my class work.

Strongly Disagree Disagree Somewhat Disagree Somewhat Agree Agree StronglyAgree

15. It's important to me to avoid looking stupid in class.

Strongly Disagree Disagree Somewhat Disagree Somewhat Agree Agree StronglyAgree

Appendix D

Revised Quality of Teacher Interactions Survey

Part Two

1. My science teacher gets angry quickly.

Never Not Often Sometimes Often Always

2. My science teacher is willing to explain things again.

Never Not Often Sometimes Often Always

3. My science teacher is quick to correct us if we break a rule.

Never Not Often Sometimes Often Always

4. My science teacher knows everything that goes on in the classroom.

Never Not Often Sometimes Often Always

5. My science teacher listens to us.

Never Not Often Sometimes Often Always

6. My science teacher is impatient.

Never Not Often Sometimes Often Always

7. My science teacher is a good leader.

Never Not Often Sometimes Often Always

8. My science teacher is not sure what to do when we misbehave.

Never Not Often Sometimes Often Always

9. My science teacher is confident.

Never Not Often Sometimes Often Always

10. My science teacher is patient.

Never Not Often Sometimes Often Always

11. My science teacher helps us with our work.

Never Not Often Sometimes Often Always

12. My science teacher is strict.

Never	Not Often	Sometimes	Often	Always

13. My science teacher is friendly.

Never	Not Often	Sometimes	Often	Always

14. My science teacher thinks that we don't know anything.

Never	Not Often	Sometimes	Often	Always

15. We are afraid of our science teacher.

Never	Not Often	Sometimes	Often	Always

16. We have to be silent in science class.

Never	Not Often	Sometimes	Often	Always

17. My science teacher is someone we can depend on.

Never	Not Often	Sometimes	Often	Always

18. My science teacher lets us misbehave in class.

Never	Not Often	Sometimes	Often	Always

19. My science teacher puts us down.

Never	Not Often	Sometimes	Often	Always

20. My science teacher lets us get away with a lot in class.

Never	Not Often	Sometimes	Often	Always

21. My science teacher thinks that we can't do things well.

Never	Not Often	Sometimes	Often	Always

22. My science teacher gives us a lot of free time in class.

Never	Not Often	Sometimes	Often	Always

Appendix E
Parental Consent
Parent/Guardian Consent for Participation in Science Motivation Study

IRB Approval #: 2008-41

Principal Investigator:
Dr. Robert Horton
Teacher Education
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409-B Tillman Hall
864-656-5127

Co-Investigator:
Julie Smart
Ph.D. Candidate
119 Rollingreen Road
Greenville, SC 29615
864-630-2157

Institutional Review Board
223 Brackett Hall
Clemson, SC 29634

Parent/Guardians,

You are being asked to give permission for your child to participate in a research study. The purpose of this study is to learn more about student motivation in science and how teacher/student interactions in the classroom affect student motivation. Each student will complete a short survey about their feelings about science and their perceptions of classroom interactions. This survey will be completed in their science classroom and will take approximately 20-30 minutes. Your child's name will not appear on this survey so that confidentiality will be protected. Several students will also be randomly selected to participate in a short, 15-minute interview with Julie Smart. These interviews would involve 2 students and would be held in the media center. Mrs. Smart will work with classroom teachers to assure that students do not miss any science instruction.

The results of this study will provide information about how students' perceptions of classroom interactions can affect their motivation in science. Since research indicates that many students experience a drop in motivation for science as they enter middle school, it is important to understand why this occurs. Motivation is critical for student achievement and can also affect future career choices. Gaining further knowledge about sixth grades' science motivation and how this is affected by classroom interactions can greatly contribute to our knowledge of how to support student more effectively in early middle grades. Gaining this information is the most important benefit of the research. There are no known risks to the current study. If you have any concerns about the risks or benefits of participating in this study, please contact Julie Smart, Dr. Robert Horton, or the IRB office at the numbers indicated above.

You have the right to refuse for your child to participate or withdraw your child at any time. If you do withdraw your child, it will not affect your child in any way. Thank you for your time and careful consideration. Please complete the portion below and return it to school at your earliest convenience.

Sincerely,
Julie Smart

Voluntary Consent by Parent of Participant

I have read the preceding consent form, or it has been read to me, and I fully understand the contents of this document and voluntarily give consent for my child to participate. All of my questions concerning the research have been answered. I hereby agree to have my child participate in this research study. If I have any questions in the future about this study they will be answered by Julie Smart. A copy of this form will be given to me. This consent ends at the conclusion of the study.

_____ **My child may participate in this project.**

_____ **My child may not participate in this project.**

Child's Name: ____

Parent's/Guardian Signature: _________________________ Date: ___________

Appendix F
Student Assent
Science Motivation and Teacher Student Interactions

You are being invited to participate in a research study. Below you will find answers to some questions you may have about the study.

What is it for?

- This study will look at how sixth grade students feel about science and the things that go in on their science classroom. This information will help researchers understand students' attitudes about science and what role their teachers play in this.

Why me?

- You are being asked to participate in this study because you are a sixth grades science student.

What will I have to do?

- You will read several groups of sentences and choose answers that tell how you feel about science and your science classroom.
- Some of you may be asked to talk to Mrs. Smart for a few minutes about how you feel about science. You would not be alone; another student from your class would come too and we would all talk in the library. We would make sure you didn't miss anything in science class.
- This study is not for a grade and there is not right or wrong answer. The only person who will see your answers and scores is the researcher who is giving you this survey.

Did my parents say it was ok?

- Your parents have already been told about this study and have given their permission for you to participate.

Who will be helped by this research?

- Researchers hope to use information from this study to help students develop more positive attitudes about science.
- Researchers also hope to help teachers learn how to make science a more positive experience for students in their class.

What if I want to stop?

- Participation in this study is completely voluntary and you can stop at any time. You will not get in trouble if you choose to stop participating in this study,

Are there any other choices?

- A survey and interviews are currently the best way to study the attitudes that students have about science and what goes on in their science class.

By signing this form, I am saying that I have read this form and have asked any questions that I might have. All of my questions have been answered so that I understand what I am being asked to do. By signing, I am saying that I am willing and I would like to participate in this study.

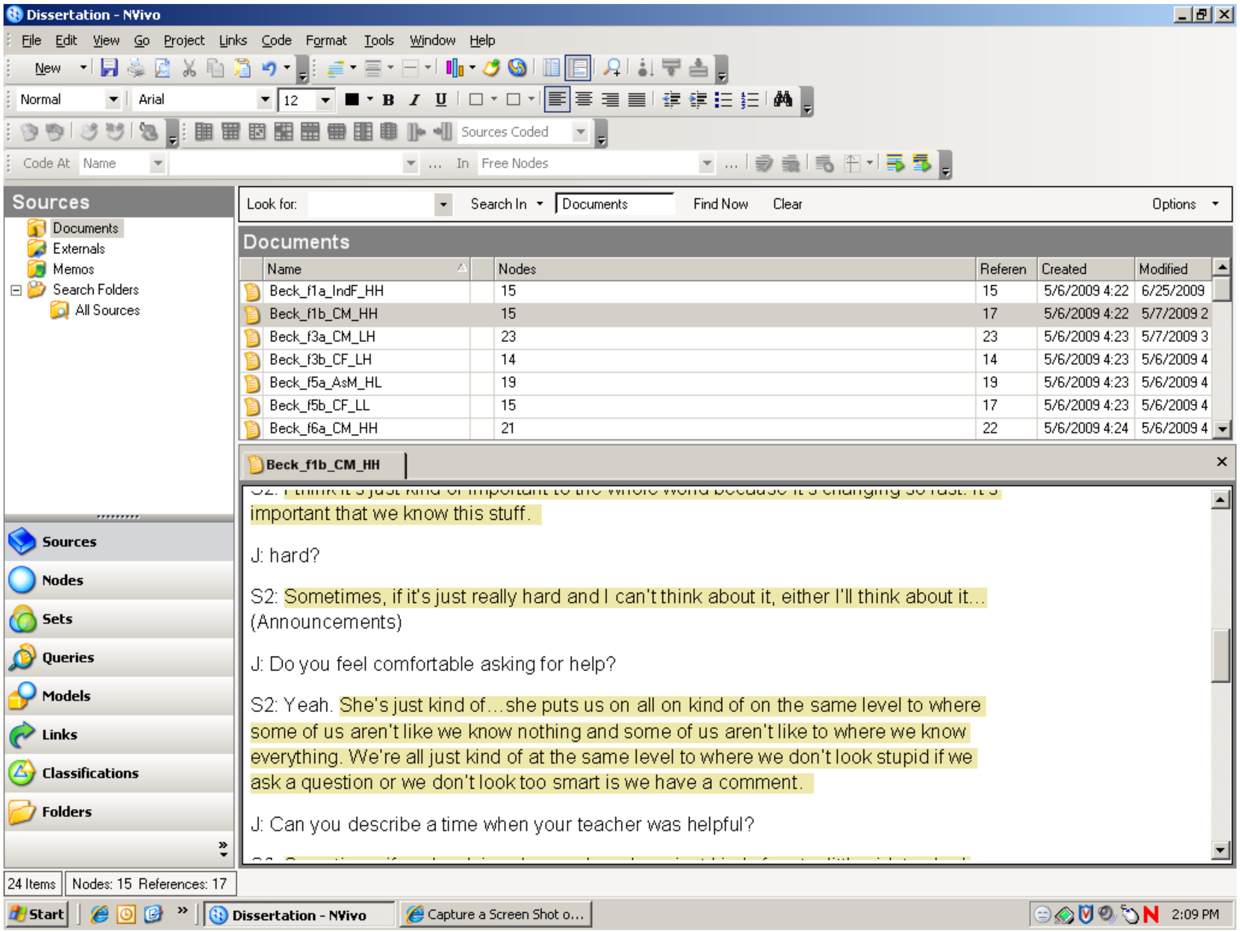
____ _____________________

Signature of Student Date

Appendix G
Semi-Structured Interview Protocol

- Do you enjoy science? Why?
- Do you feel like you are good at science? What makes you feel that way?
- Do you think that science is important? Why do you think this?
- Does your teacher think that science is important? What does she do that helps you know that?
- If you have something important to say, will your science teacher listen to you?
- How does that make you feel about science?
- What do you do when you have a difficult problem or question in science?
- If you don’t understand something in science class, what do you do?
- Do you feel comfortable asking your teacher for help in science? Why? Why not?
- Do you feel like you need to compete with other students in science class?
- How does your science teacher handle student behavior in your class?
- How do you feel about the way your teacher talks to you in science class?
- Can you describe your science teacher for me?
- What is your favorite thing about your science teacher? Can you give me an example?
- What is something you wish you could change about your science teacher? Can you give me an example?
- Can you describe a time when your teacher was helpful in science class?
- Possible follow-up…How did that make you feel about learning science?
- Possible follow-up…Can you talk about a time when your teacher was patient in science class?
- Possible follow-up: Can you think of a time that your teacher gave you freedom in science class?
- How did that make you feel about learning science?

Appendix H
NVIVO Screen Capture: Open Coding Example



Appendix I
Free Nodes from Open Coding Phase

Free Nodes

Name	Sources
admonishing_communicating that the class is bad	1
admonishing_gets mad easily	6
admonishing_getting angry at entire class for somthing only some students have done	3
admonishing_losing instructional time with lectures	1
admonishing_picking student out	1
choice_allows for creativity	1
choice_depending on activity	2
choice_extra credit	2
choice_limited	4
choice_none	2
choice_partners	1
choice_represent different points of view	1
choice_select topic	2
choice_student voice	1
comfortable approaching teacher	1
competitive	5
confidence depends on activity	2
confident	6
confident_attribution to teacher	2
desire for more choice about labs	2
desire for more hands-on	2
desire more choice about topics	1
desire_more independence	3
desire_more social time	1
dislike_angry teacher	2
dislike_busy work	1
dislike_excessive work	2
dislike_feeling unprepared for tests	1
dislike_specific content	2
dislike_talking alot of notes	4
dislike_teacher getting mad at one students and taking it out on the whole class	1
dislike_teacher getting off-topic	2
dislike_teacher lecturing	1
dislike_teacher looking over shoulder constantly	1
dislike_unfamiliar content	1
dislike_writing up labs	1
dislikes_unclear instructions	1
enjoy_energy	1
enjoy_independence	3
enjoy_no	3
enjoy_problem-solving actitivity	2
enjoy_relaxed atmosphere	1

Free Nodes

Name	Sources
enjoy_social group discussions in science	1
enjoyment_attribution to teacher	2
enjoyment_competitive activity	1
enjoyment_feeling like a scientist	1
enjoyment_field trip with real-life applications of science	1
enjoyment_hands-on activity	18
enjoyment_interactive subject	9
enjoyment_learning new things	2
enjoyment_real world connection	3
feeling that teacher doesn't trust them	1
future importance_none	1
future science-related career	6
helpful_approachable	1
helpful_available	5
helpful_challenges with additional questioning	1
helpful_detailed explanation	5
helpful_getting points back on test	2
helpful_instructional strategies	7
helpful_keeping students informed	1
helpful_monitoring and scaffolding	2
helpful_perceptive	1
helpful_personlity and sense of humor	1
helpful_plans engaging activities	1
helpful_proactively give help	3
helpful_pushes you to think	1
helpful_simple directions	1
helpful_supportive	5
helpful_teacher as expert	1
helpful_timeline on making up work	1
helpful_using notes on a test	2
impatient_gets mad easily	2
impatient_giving excessive work	2
impatient_not listening to students' reasons for not finishing work	2
impatient_teacher getting angry when students don't understand something	2
important for future_weather safety	2
important in future_environment	2
important in future_for science careers	7
important in future_unsure	1
important in the future_making good grades so you can play sports	1
important_able to identify animals	1
important_cooking and kitchen	2
important_environment	2

Free Nodes

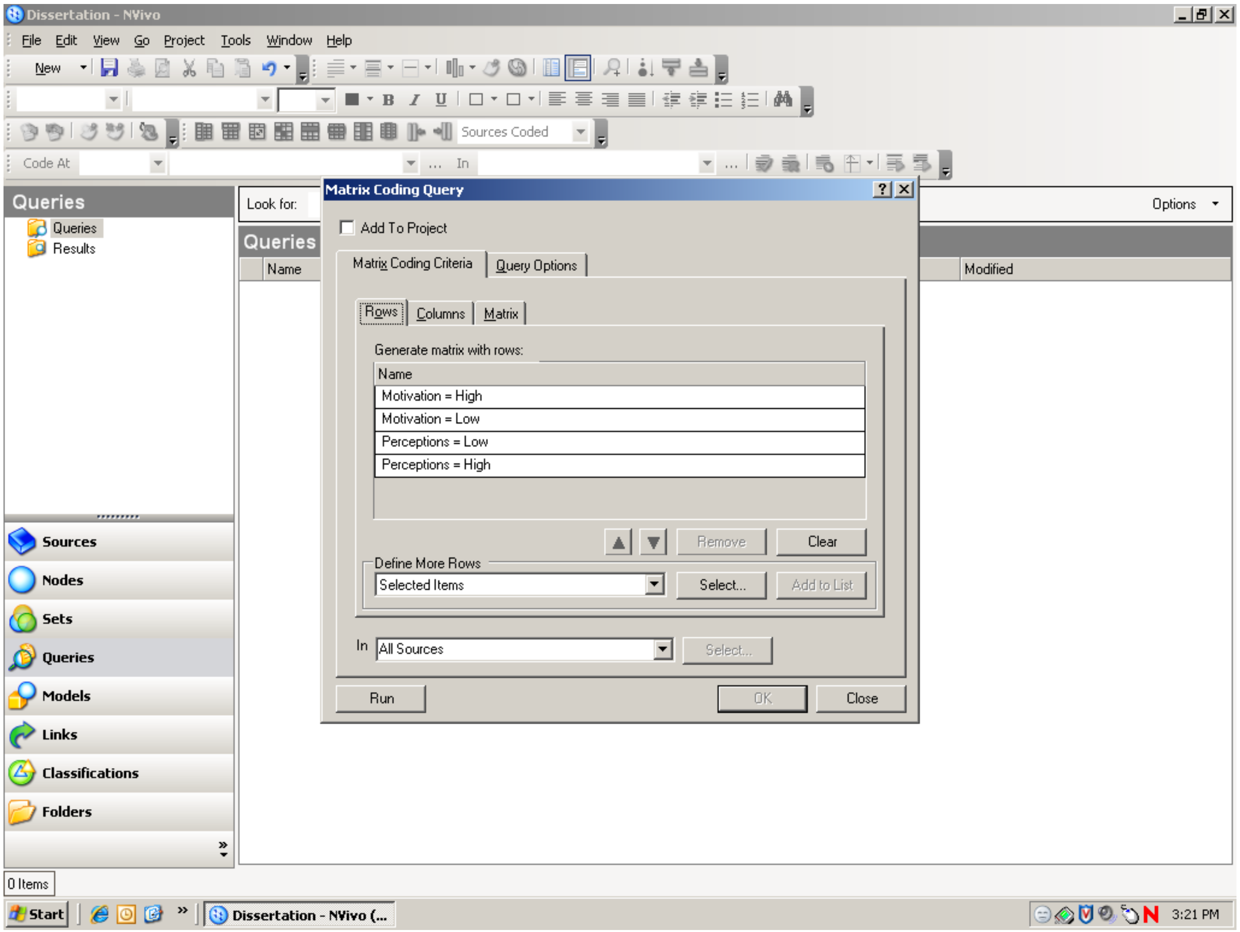
Name	Sources
important_for doing homework	1
important_gardening	1
important_hygiene	1
important_safety	1
important_technology	1
important_understanding the human body	1
important_understanding the world	7
important_weather prediction	1
lack of confidence	2
leadership_verbal affirmation	1
like_experiments with learning	1
like_independence in labs	1
like_more space and freedom	1
like_teacher being interactice with class	3
like_teacher creativity	1
like_teacher goes beyond what is necessary	2
like_treats in science class	2
low efficacy for science	1
low value for science	1
math important_relevant	2
middle school science_a little more interesting	1
middle school science_builds on elementary science	1
middle school science_developmentally appropriate	1
middle school science_easier than elementary	1
middle school science_less hands-on	2
middle school science_less use of technology	1
middle school science_less videos	1
middle school science_less work with actual animals	1
middle school science_more demanding cognitively	7
middle school science_more detailed	8
middle school science_more hands on	2
middle school science_more projects	1
middle school science_more responsibilities	4
middle school science_more workbook work	1
middle school science_move around more	1
middle school science_some smaller classes	1
negative adjective	6
neutral adjective	1
not important day to day	2
not important_hard content	1
not important_lack of relevance	1
patient_empathetic	2

Free Nodes

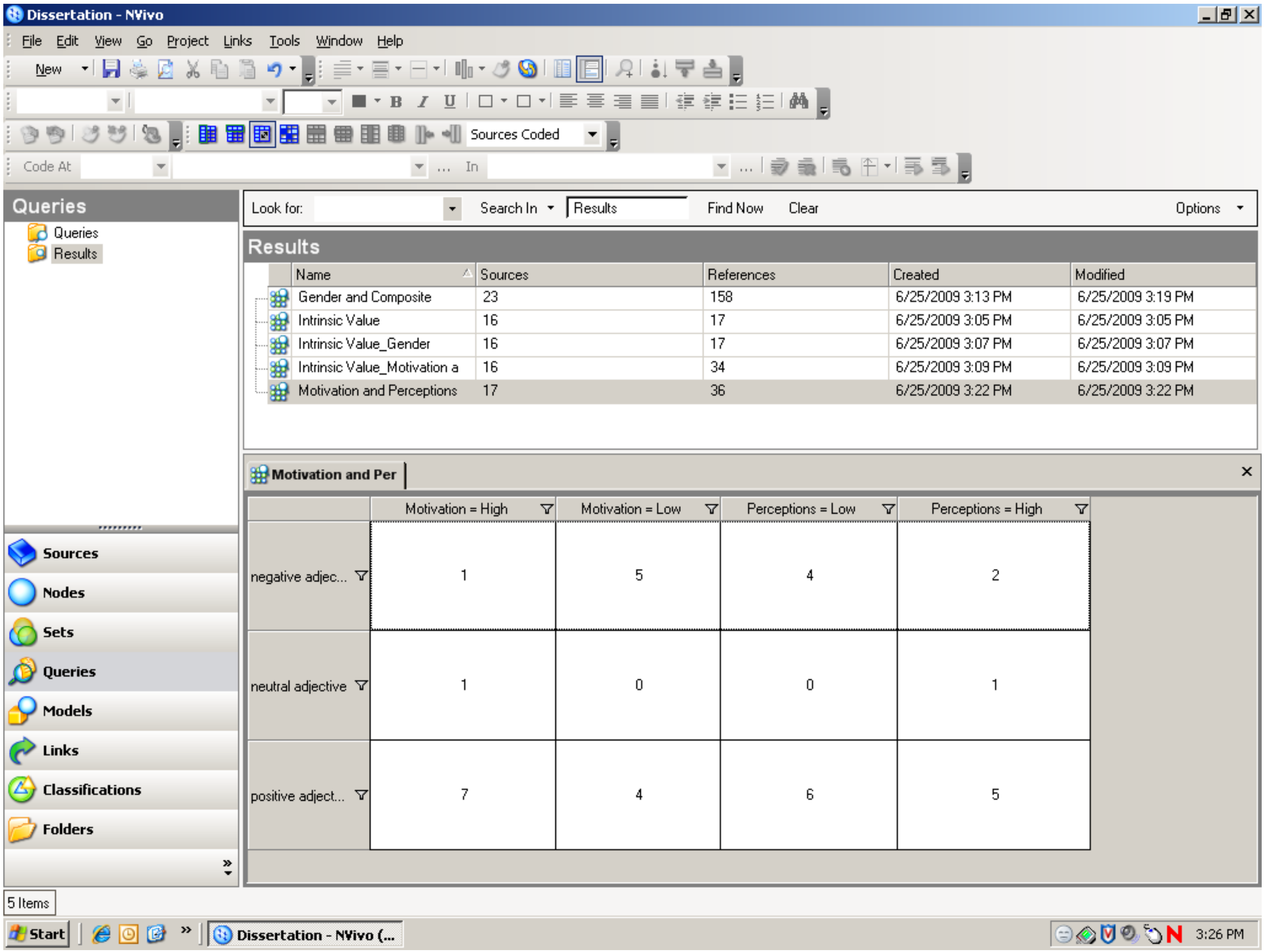
Name	Sources
patient_individual time for students	3
patient_slow to anger	3
patient_wait time	5
patient_when students don't understand	4
positive adjective	11
science_boring	1
science_boring because of content	1
science_chance to be inquisitive	2
science_difficult	1
science_interesting content	1
science_unique subject	1
science_unretaled to other subjects	1
strategies_seek help from peers	4
strategies_self-regulation	8
strategies_text and notes	4
strategy_go to teacher after using self-regulation	2
strategy_seek help from teacher	6
strategy_self-reflection	3
stretegies_teacher then peers	2
strict_enforcing procedures	9
strict_limited patience	2
strict_makes student feel uncomfortable	1
strict_many rules	1
Strict_more work	1
strict_singling student out	1
strict_students lying	1
strict_tight teacher control	2
strict_when needed to maintain learning environment	14
teacher leadership_treating students as equals	1
teacher showing mutual respect	1
uncomfortable approaching teacher	3
unhelpful	1
value_parent's career	1

Appendix J
NVIVO Query Procedures

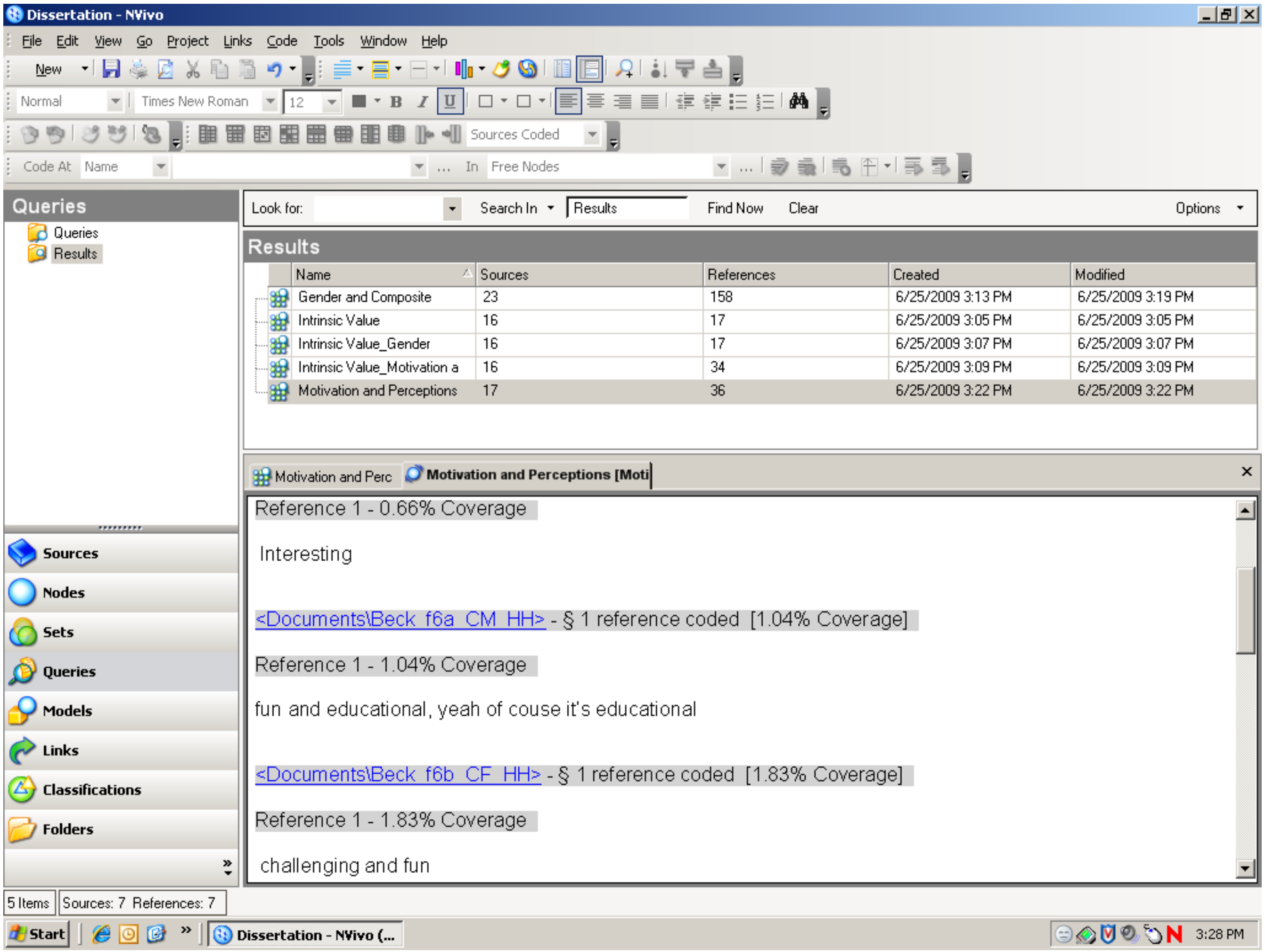
(1) Run matrix query: Motivation Level & Perception Level vs. Intrinsic Value for Science



(2) Examine matrix: Rows: Intrinsic Value for Science
Columns: Motivation Level and Perception Level



(3) Expand cell: High motivation and Positive Intrinsic Value for Science



Appendix J (cont.)

(4) Examine percentages by row